

<b>EPA</b> United States Environmental Protection Agency Washington, DC 20460 <b>Work Assignment</b>						Work Assignment Number 3-03				
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:				
Contract Number EP-C-12-011			Contract Period   02/01/2012   To   09/30/2015 Base                      Option Period Number       3			Title of Work Assignment/SF Site Name Powertrain Test and Validation				
Contractor ICF Incorporated, L.L.C.					Specify Section and paragraph of Contract SOW Task 2 Light Duty and Heavy Duty Vehicles Analyses					
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval						Period of Performance  From   10/29/2014   To   01/31/2015				
Comments:										
<div style="display: flex; justify-content: space-between;"> <input type="checkbox"/> Superfund         <span>Accounting and Appropriations Data</span> <input checked="" type="checkbox"/> Non-Superfund       </div>										
Note: To report additional accounting and appropriations date use EPA Form 1900-69A.										
SFO (Max 2) <input type="checkbox"/>										
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
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5										
Authorized Work Assignment Ceiling										
Contract Period:		Cost/Fee:			LOE:					
02/01/2012   To   09/30/2015										
This Action:										
Total:										
Work Plan / Cost Estimate Approvals										
Contractor WP Dated:				Cost/Fee:			LOE:			
Cumulative Approved:				Cost/Fee:			LOE:			
Work Assignment Manager Name   Houshun Zhang  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number   734-214-4214 FAX Number:			
Project Officer Name   Greg Janssen  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number: 734-214-4285 FAX Number:   734-214-4821			
Other Agency Official Name   Jose Ortiz  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number: 513-487-2831 FAX Number:   513-487-2109			
Contracting Official Name   Sandra Savage  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number: 513-487-2046 FAX Number:			

## PERFORMANCE WORK STATEMENT

EPA Contract:	EP-C-12-011
Work Assignment (WA):	3-03
Issuing Office:	EPA Office of Transportation and Air Quality (OTAQ) 2000 Traverwood Dr. Ann Arbor, Michigan 48105
Contractor:	ICF International 9300 Lee Highway Fairfax, VA 22031-1207
Statement of Work:	Powertrain Tests and Validations, <i>Continuation</i>
Work Assignment Contract Officer Representative (WA COR):	<u>Houshun Zhang</u> 734-214-4214 zhang.houshun@epa.gov
Alternate WA COR:	<u>Christine Brunner</u> 734-214-4287 brunner.christine@epa.gov

### I. BACKGROUND

The U.S. Environmental Protection Agency (EPA) and the Department of Transportation's National Highway Traffic Safety Administration (NHTSA) recently announced a first-ever program to reduce greenhouse gas (GHG) emissions and improve fuel efficiency of heavy-duty trucks and buses. This program is the first phase of the multi-stage GHG reduction approach. Hybrid system certification is part of the program. Due to technical challenges to quantify hybrid vehicle benefits as opposed to conventional vehicles, the agencies, working together with industrial stakeholders, are developing different concepts for certification. One of the concepts is powertrain test or powerpack test approach. The powertrain system includes engine, hybrid related components, and transmission. This approach must rely on a conventional baseline for use of comparison with the new hybrid system. The challenge is how to select, test, and validate this conventional powertrain baseline system without the hybrid system. To date very little work has been done in this area. Consequently, this work assignment will continue the efforts to select, test, and validate the baseline powertrain system before moving to the more complicated hybrid system.



## **II. SCOPE OF WORK**

The contractor shall provide all required management, employee training, licensed personnel, permits, equipment, labor, materials, tools, personal protective equipment, and other items needed to accomplish each task. As novel and unexpected results may occur due to the nature of the work, the EPA WA COR may provide technical direction via phone, email or in person followed-up with confirmatory written technical direction during testing.

This work assignment (WA) continues work started under WAs 0-03, 1-03, and 2-03 of this contract. Task numbering under this WA follows the sequence found in WA 2-03. The contractor shall complete Task 10 from WA 2-03; Task 10 is presented below in its entirety.

### **Task 10      Heavy Duty Engine Benchmark**

The contractor shall test either a 2013 Detroit Diesel DD15AT or Navistar Maxxforce 13 engine with the highest power rating on market. The contractor shall first identify the potential highest and lowest rating the engine can run. Once the boundary of the rating is identified, the contractor shall get new calibrations to refresh the engine control module (ECM), where the new calibrations can be obtained from either a dealer or from original equipment manufacturer (OEM) for all possible ratings between the lowest and highest ratings.

The contractor shall conduct engine mapping at the highest rating. The operating points shall cover the following operating points:

- Full torque curve as a function of engine speeds from idle to highest speed.
- Speed range: idle to highest possible speed in the following format:
  - idle, 700, 800, 900, 1000, 1100, 1200, 1250, 1300, 1400, 1500, 1550, 1600, 1700, 1800, 1950, 2100
  - Two more speed points from the rated speed to the speed close to or at governor limited speed.
- Load range: 100%, 90%, 75%, 60%, 50%, 35%, 25%, 10%, 5%, 0% at each speed.
- Engine friction torque curve
  - Motoring curve as function of speed from idle to rated speed

The contractor shall run the following tests at each rating:

- The full torque curve as function of the engine speed. These torque curves will be used to get the engine fuel maps for each rating.
- Supplemental Emissions Test (SET) for all 13 modes and calculated composite brake specific fuel consumption (BSFC) and CO<sub>2</sub> based on measurements
- Hot FTP cycles with measured BSFC and CO<sub>2</sub>
- World-harmonized test cycle (WHTC) with measured BSFC and CO<sub>2</sub>
- EPA-certified CARB cycle with measured BSFC and CO<sub>2</sub>

For the CARB cycle, the EPA WA COR will provide the engine torque and speed to the contractor. This information will be obtained from the vehicle simulation, allowing for a simulated vehicle run using the engine dyno. For all cycles, three repeatable runs are required.

#### **IV. DELIVERABLES**

##### **1. Develop Quality Assurance Project Plan**

The QAPP prepared for WA 2-03 shall be effective for this WA 3-03. A new QAPP is not required.

Nonetheless, the contractor shall notify the EPA WA COR immediately if they encounter any equipment failures that cannot be remedied, problems that may impact the quality or on-time receipt of deliverables, or unavailability of items required for this work assignment.

##### **2. Regular Progress Reports**

The contractor shall provide the EPA WA COR with regular status reports via telephone conference or email during the period of performance. The frequency of the progress report can be adjusted as weekly or bi-weekly depending on the progress of the program. The progress report shall indicate the progress achieved in the concluded weeks, technical problems encountered, solutions to those problems, and projected activity for the upcoming weeks. Before proceeding with any solution to a problem, the contractor shall report the problem and consult with the EPA WA COR concerning the scope of the solution.

##### **3. Technical Reports**

The contractor shall provide the EPA WA COR with a brief Technical Report upon completion of each task. Depending on the complexity of the subject matter and as directed via written technical direction by the EPA WA COR, these reports shall be in the form of either a presentation or a formal written document. Written products shall be delivered in formats specified by the EPA WA COR (e.g., Word, Excel).

##### **4. Data**

The contractor shall provide the EPA WA COR with raw test data within 2 business days of receiving request for such data via written technical direction from the EPA WA COR. The contractor shall provide to the EPA WA COR valid test data from a vehicle (per task) within 14 days of completion of the testing on the vehicle. All data shall be presented in Excel format.

##### **5. Draft and Final Reports**

The contractor shall provide to the EPA WA COR a Draft Final Report and data set summarizing the results of all tasks within 30 days of completion of the laboratory and modeling work contained in this work assignment. The contractor shall deliver the Final Report within 15 days

of receipt of comments from the EPA WA COR. All reports and associated materials (e.g., data sets) shall be provided in formats specified by the EPA WA COR.

#### **Schedule of Deliverables**

<b>Steps</b>	<b>Completion Date</b>
Complete all tasks	December 31, 2014
Test Data	<u>Raw data</u> - within 2 business days of EPA WA COR request <u>Engine test data</u> - within 14 days of completion of the testing on an engine
Draft Final Report	Within 30 days of completion of all tasks
Final Report	Within 15 days of receipt of EPA comments on Draft Final Report

#### **NON-DISCLOSURE AGREEMENT**

All documentation acquired and/or provided by EPA or generated as a result of this project shall be under the control of the U.S. EPA Assistant Administrator for Air and Radiation, or his or her designated representative, and shall not be released by the Contractor to any other source without specific approval by U.S. EPA.

<b>EPA</b> United States Environmental Protection Agency Washington, DC 20460 <b>Work Assignment</b>						Work Assignment Number 3-04				
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:				
Contract Number EP-C-12-011			Contract Period 02/01/2012 To 09/30/2015			Title of Work Assignment/SF Site Name				
			Base                      Option Period Number                      3			Aerodynamic Trailer Assessment				
Contractor ICF Incorporated, L.L.C.					Specify Section and paragraph of Contract SOW Task 2 Light Duty and Heavy Duty Analysis					
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval					Period of Performance  From 10/01/2014 To 09/30/2015					
Comments: This work assignment continues work begun under WA 2-04. The Performance Work Statement and requirements remain the same as in WA 2-04. Note that the ICF work plan dated 8/29/2014 differentiated those tasks that would continue into WA 3-04. That same work plan with any appropriate revisions may be submitted in response to this Work Assignment 3-04.										
<input type="checkbox"/> Superfund                      Accounting and Appropriations Data <input checked="" type="checkbox"/> Non-Superfund										
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.										
SFO (Max 2) <input type="checkbox"/>										
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										
Authorized Work Assignment Ceiling										
Contract Period:                      Cost/Fee:                      LOE: 02/01/2012 To 09/30/2015										
This Action:										
Total:										
Work Plan / Cost Estimate Approvals										
Contractor WP Dated:                      Cost/Fee:                      LOE:										
Cumulative Approved:                      Cost/Fee:                      LOE:										
Work Assignment Manager Name Arvon Mitcham  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number 734-214-4522 FAX Number:			
Project Officer Name Greg Janssen  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number: 734-214-4285 FAX Number: 734-214-4821			
Other Agency Official Name  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number: FAX Number:			
Contracting Official Name Sandra Savage  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number: 513-487-2046 FAX Number:			

## PERFORMANCE WORK STATEMENT

EPA Contract: EP-C-12-011

Work Assignment (WA): 3-04

Issuing Office: EPA Office of Transportation and Air Quality (OTAQ)  
2000 Traverwood Dr.  
Ann Arbor, Michigan 48105

Contractor: ICF International  
9300 Lee Highway  
Fairfax, VA 22031-1207

Statement of Work Title: Aerodynamic Trailer Component Assessment and  
Impact on the Green House Gas Emissions from  
Heavy-Duty Combination Vehicles

Work Assignment Contract  
Officer Representative (WA COR): Arvon Mitcham  
2000 Traverwood Drive  
Ann Arbor, MI 48105  
734-214-4522  
[mitcham.arvon@epa.gov](mailto:mitcham.arvon@epa.gov)

Alternate WA COR: Houshun Zhang  
2000 Traverwood Drive  
Ann Arbor, MI 48105  
734-214-4214  
[zhang.houshun@epa.gov](mailto:zhang.houshun@epa.gov)

Period of Performance: October 1, 2014 – September 30, 2015

### I. BACKGROUND

On September 15, 2011, the United States Environmental Protection Agency (U.S. EPA) and the National Highway Traffic Safety Administration (NHTSA) published a final rulemaking establishing Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles (HD GHG Phase 1). This program was the first of its kind focused on reducing greenhouse gas (GHG) emissions and improving the fuel efficiency of heavy-duty trucks and buses; it is projected to reduce CO<sub>2</sub> emissions by about 270 million metric tons and save about 530 million barrels of oil over the life of model year 2014 to 2018 vehicles.

As part of this rulemaking effort, an emphasis was placed on reducing the aerodynamic drag of heavy-duty trucks, specifically Class 7 and 8 combination tractors. Class 7 and 8 combination tractors and their engines contribute the largest portion of the total GHG emissions and fuel consumption (approximately 65 percent) of the heavy-duty sector, due to their large payloads, their high annual miles traveled, and their major role in national freight transport. Based on empirical studies of Class 8 Tractors, a 1% improvement in aerodynamic drag equates to a 0.5% improvement in fuel economy, and consequently equates to lower GHG emissions for HD Class 8 Tractor-Trailer combinations. Therefore, reducing the amount of aerodynamic drag on a Class 7/8 combination tractor-trailer reduces the GHG emissions, fuel consumption, and overall operating cost for a Class 7/8 combination tractor.

EPA is now developing a second phase of HD GHG regulations (HD GHG Phase 2). As done previously in HD GHG Phase 1, reduction in aerodynamic drag on a Class 7/8 combination tractor trailer will be a major focus. Specifically, EPA is considering including HD trailers as part of the rule to further increase fuel economy and lower GHG emissions from Class 7/8 Tractor-Trailer combinations. This allows EPA to take a systems approach by looking at the tractor-trailer combination as an entire vehicle, not just focusing on the Class 7/8 engine and tractor separately from the trailer. The inclusion of trailers should provide additional benefits in HD GHG Phase 2 and build on the success and achievements in HD GHG Phase 1.

## **II. SCOPE**

For HD GHG Phase 2, we need to evaluate 1) the relationship between aerodynamic trailer devices and fuel consumption/CO<sub>2</sub> emissions and 2) the cost-benefit of including trailers used with Class 7/8 tractors for HD GHG Phase 2. Determining the costs and potential benefits of aftermarket or original equipment trailer aerodynamic devices (e.g., side skirts, boat tails, and front trailer treatments) is required to improve vehicle aerodynamic performance and reduce GHG emissions of HD Class 7/8 Tractor-Trailer combinations.

The various aerodynamic methods from HD GHG Phase 1 (e.g., coastdown, reduced scale wind tunnels) shall be used to evaluate and characterize the performance of trailers and trailer aero technology and feed this into EPA's Greenhouse Gas Emissions Model (GEM)<sup>1</sup> to determine the potential GHG impact and output, and assist in HD GHG Phase 2 standard setting. This shall require:

1. On-Road Evaluation using the Coastdown and Constant Speed on full-size, Class 7/8 Tractor Trailer combinations with and without aerodynamic trailer devices installed, individually and in combination, to quantify the aerodynamic drag change aerodynamic trailer devices;
2. Wind Tunnel Evaluation of 1/8<sup>th</sup> (12.5%) scale Class 7/8 Tractor-Trailer combinations with and without aerodynamic trailer devices installed, individually and in combination, to quantify the aerodynamic drag change from aerodynamic trailer devices; and
3. Cost and cost-benefit analysis of the various aftermarket or OEM trailer aerodynamic devices (e.g., side skirts, boat tails, front trailer treatments).

## **III. TASKS**

The tasks below outline the functions that shall be performed by the contractor under this work assignment. Tasks 5 and 6 shall be performed by the contractor only after receipt of written technical direction from the EPA WA COR. However, the contractor shall provide cost information for each task and sub-task in the work plan.

In the event that the contractor estimates the required tasks will not be completed in the current period of performance, the contractor shall submit a work plan and cost proposal for the work that is anticipated to be completed during the current period of performance, and a separate work plan and cost proposal for the work that is anticipated to carry over into the next term. The contractor shall include the specific tasks and/or subtasks and corresponding timing for work to be completed during the current performance period and the carry-over work in the respective work plans.

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<sup>1</sup> EPA's Greenhouse Gas Emissions Model (GEM) is a free, desktop computer application that estimates the GHG emissions and fuel efficiency performance of specific aspects of heavy duty vehicles based on the manufacturer inputs of aerodynamic drag engine fuel map, tire rolling distance, weight reduction, and extended idle strategy for each tractor model in the manufacturer's fleet.

The contractor shall provide all required management, employee training, licensed personnel, permits, equipment, labor, materials, tools, personal protective equipment, and other items needed to accomplish each task. As novel and unexpected results may occur due to the nature of the work, the EPA WA COR may provide technical direction via phone, email or in person, followed-up with written technical direction.

### **Task 1: Tractor Trucks, Trailers, Trailer Aerodynamic Devices and Equipment**

The tests specified in this work assignment shall be conducted on various OEM highway Class 8 sleeper and day cab tractor trucks equipped with an aerodynamic package with a standard (non- SmartWay) 53' foot box trailer. Specifically, the on-road tests shall be conducted with one OEM on-highway Class 8 sleeper cab and day cab tractor truck equipped with an aerodynamic package; with a standard (non-SmartWay) 53' foot box trailer. In addition, the reduced-scale wind tunnel (RSWT) testing shall be conducted with four OEM on-highway Class 8 sleeper cabs and one day cab tractor truck equipped with an aerodynamic package; with three standard (non- SmartWay) 53' foot box trailers. The trailers shall be tested in standard configuration and with various aerodynamic trailer devices installed according to the test plans supplied by the EPA WA COR to the contractor.

The contractor may be required by or allowed to perform additional configurations of the tractor- trailer combination as provided in written technical direction from the EPA WA COR.

For the purposes of this work assignment, the vehicles, trailers and tires used will not become government furnished property. The Contractor shall ensure appropriate disposition of the vehicles, trailers and tires after all testing is completed, including removal of all instrumentation and returning any vehicles and trailer used in this task to production configuration.

Following completion of this work assignment, the Contractor shall ensure appropriate disposition of aerodynamic trailer devices and test equipment considered government furnished property.

#### Task 1a. Heavy Duty Class 8 Sleeper Cab Tractor Truck

The contractor shall conduct testing under this work assignment on one long haul, Class 8, 2012 Volvo VNL780 High Roof Sleeper Cab tractor equipped with an aerodynamic package. The truck shall be equipped with an engine that meets the 0.20g/hphr of Nox. To maintain consistency, EPA prefers that vehicles with Cummins ISX engines be used. The Contractor shall ensure EPA WA COR approval of the proposed truck/engine combination.

#### Task 1b. Heavy Duty Class 8 Day Cab Tractor Truck

The contractor shall conduct testing under this work assignment on one Class 8, 2012 Navistar ProStar High Roof Day Cab tractor equipped with an aerodynamic package. The truck shall be equipped with an engine that meets the 0.20g/hphr of NOx. To maintain consistency, EPA prefers that vehicles with Cummins ISX engines be used. The Contractor shall ensure EPA WA COR approval of the proposed truck/engine combination.

#### Task 1c. 53' Dry Box Van Trailer

The contractor shall utilize the 2008-09 Wabash 53' Dry Box Van Trailer used for testing under WA #0-03, #1-03 and #2-03 of this contract, and currently in possession of Southwest Research Institute, to conduct testing under this work assignment. If the

contractor does not have access to this trailer, they shall notify the EPA WA COR and include the cost of acquiring this trailer in the work plan.

The trailer used for testing shall meet the requirements of 40 CFR 1037.501 (g)(1), with the exception that aerodynamic features are permitted. This includes the technical amendments made to this section after the rule that updated the specifications for the trailer rear axle measurement.<sup>2</sup>

#### Task 1d. Aerodynamic Trailer Devices

The contractor shall utilize the aerodynamic trailer devices used for testing under WA #0-03, #1-03 and #2-03 of this contract, and currently in possession of Southwest Research Institute, to conduct testing under this work assignment. Specifically, the Contractor shall utilize trailer skirt and aft device/boat tail, individually and in combination for testing under this work assignment. If the contractor does not have access to this equipment, they shall notify the EPA WA COR and include the cost of acquiring this equipment in the work plan.

#### Task 1e. On-Road Test Equipment

The contractor shall utilize the equipment used for testing under WA #0-03, #1-03 and #2-03 of this contract, and currently in possession of Southwest Research Institute, to conduct testing under this work assignment. If the contractor does not have access to this equipment, they shall notify the EPA WA COR and include the cost of acquiring this equipment in the work plan.

#### Task 1f. Reduced Scale Wind Tunnel Test Equipment

The contractor shall utilize detailed, in-house models of 1/8<sup>th</sup> (12.5%) scale Class 7/8 tractor-trailers, 53 foot dry box van trailers, and aerodynamic trailer devices (trailer skirts, aft device/Trailer Tail, and trailer front device/gap reducer); for testing in different combinations to evaluate tractor/trailer/device aerodynamics. All models of tractors, trailers and aerodynamic trailer devices used in performance of this work assignment shall not be considered government furnished property.

### **Task 2: On-Road, Evaluations of a Full-Size Class 7/8 Tractor-Trailer Combination with and without Aerodynamic Trailer Devices**

The contractor shall conduct on-road evaluations by performing the Coastdown and Constant Speed, on one full-size, Class 7/8 Tractor-Trailer combination with and without aerodynamic trailer devices installed, individually and in combination, to quantify the aerodynamic drag change aerodynamic trailer devices. The Class 7/8 tractor, trailer and aerodynamic devices to be evaluated are provided under the subtasks below for each test procedure. Additional detail on test scenario/case set-up for each sub-task will be provided to the contractor by the EPA WA COR via written technical direction. The contractor shall furnish results of this task to the EPA WA COR as they become available. The contractor shall include a summary of all results from this task in the final report.

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<sup>2</sup> <http://www.gpo.gov/fdsys/pkg/FR-2013-06-17/pdf/2013-11980.pdf>; see #24 on page 36392, near bottom right (italics indicate modified language: “§ 1037.501 General testing and modeling provisions. \* \* \* \* (g) \* \* \* (1) \* \* \* (iv) It includes dual 22.5 inch wheels, standard mudflaps, and standard landing gear. The centerline of the rear tandem axle must be 146 ± 4 inches from the rear of the trailer.”



For all sub-tasks under this task, the contractor shall provide EPA with the raw data in CSV format for all valid and invalid runs. The files shall include:

- Vehicle speed
- Relative wind speed, measured by the onboard anemometer
- Relative wind angle, measured by the onboard anemometer
- Run number
- Run direction
- Validity of run
- Vehicle configuration (i.e. tractor-trailer configuration)
- Date and time
- Ambient weather conditions (wind speed, wind direction, temperature)
- GPS coordinates
- Road grade as a function of time
- Other information, comments or notes related to the test runs (e.g., test weight, tractor-trailer gap width, bogey position, kingpin setting)
- Photos of the tractor, trailer, aerodynamic device and relevant equipment for each tested configuration.

Additional testing details will be provided to the contractor by the EPA WA COR via written technical direction. Potential sources for the work under this task are available upon request.

Upon completion of all subtasks under this task, and once the test program is completed and all data has received QA/QC review and approval, the contractor shall remove all instrumentation and return the truck to production configuration.

#### Task 2a. Coastdown Testing

The work under this sub-task is identical to coastdown testing performed under work assignment (WA) #0-03 and #1-03 of this contract, with the exception that the Class 7/8 tractors used for testing are different as discussed above in Task 1 of this work assignment.

The contractor shall perform coastdown testing on a model year 2012 Volvo VNL780 and a 2012 Navistar ProStar High Roof Day Cab, both with a Wabash 53' box trailer and aerodynamic trailer devices in the following configurations:

- 1) 2012 Navistar ProStar High Roof Sleeper Cab with trailer skirt and aft device/boat tail.
- 2) 2012 Navistar ProStar High Roof Day Cab with baseline trailer;
- 3) 2012 Navistar ProStar High Roof Day Cab with trailer skirt;
- 4) 2012 Navistar ProStar High Roof Day Cab with trailer skirt and aft device/boat tail.
- 5) 2012 Volvo VNL780 High Roof Sleeper Cab with baseline trailer;
- 6) 2012 Volvo VNL780 High Roof Sleeper Cab with trailer skirt;
- 7) 2012 Volvo VNL780 High Roof Sleeper Cab with trailer skirt and aft device/boat tail.

The contractor shall use the coastdown procedure described in 40 CFR Part 1066.310 of Title 40, with the following exceptions and additions:

- The contractor shall conduct coastdown testing to provide ten valid runs in each direction. If ten valid runs cannot be completed synchronously, the contractor is allowed to perform seven, at a minimum, or more valid runs in each direction.
- The contractor shall coast each vehicle configuration down from 70 mph to 0 mph (stop).

- The contractor shall provide EPA with grade data along the location of track or road. If the grade is constant through the length of track or road over which the coastdowns are conducted, the contractor shall instead provide this constant value. If EPA determines this value is insufficient, then the contractor upon request from EPA shall provide EPA with the location-specific grade.
- The contractor shall collect relative wind speed data during coastdowns using an anemometer mounted on the trailer approximately 1- meter above the trailer roof, at the midpoint of the trailer width, and within in 0-2 meters of the front of the trailer. The anemometer shall be approved by EPA WA COR before use.
- The contractor shall make appropriate modifications to the baseline (compliant) trailer for the test configurations stated above.

#### Task 2b. Constant Speed Testing

The contractor shall use the same Class 7/8 tractor trucks and 53' foot dry box van trailer from Task 2a to conduct a constant speed test to determine truck aerodynamic drag coefficient and rolling resistance. The work under this sub-task is identical to constant speed testing performed under work assignment (WA) #2-03 of this contract, with the exception that the Class 7/8 tractors used for testing are different, as discussed above in Task 1 of this work assignment. Under this task, the Contractor shall conduct constant speed testing on the same configurations identified in Task 2a of this work assignment.

Additional constant speed testing configurations shall be performed by the contractor only after receipt of written technical direction from the EPA WA COR. Specifically, additional configurations tested may include the trailer with no aerodynamic devices (baseline) and the trailer equipped with both the trailer skirt and aft device/boat tail as identified in Task 2a of this work assignment.

The contractor shall use four High Resolution Truck Torque Wheel Transducers with approximate 5 lb-ft. resolution as discussed in Task 1e during testing of each of the trucks. In addition, the contractor shall use mechanical protection against high torque application (both acceleration and braking) telemetry, and associated wheel adapters, encoder, amplifier, and power supply.

The contractor shall use an in-line strain-gauged torque flange, which will be used to measure driveshaft torque during the testing each of the trucks (i.e., driveshaft torque sensor). The torque flange shall be an ANSI C12.20 0.5 class meter with a range of 0 to 5,000 Newton- meters (N-m). These torque meters take special adapters and cannot be connected directly to the drive shaft. A modified drive shaft shall be acquired for each truck to accommodate the torque meter. These drive shafts shall be dynamically balanced.

The contractor shall use the driveshaft torque sensor and wheel hub meters simultaneously to collect data at the drive shaft and the wheels for comparison. The driveshaft torque sensor shall be calibrated according to the procedure stated in 40 CFR §1065.310.

The contractor shall collect relative wind speed data during constant speed testing using an anemometer mounted on the trailer approximately 1 meter above the trailer roof, at the midpoint of the trailer width, and within 0-2 meters of the front of the trailer. The anemometer shall be the same as the anemometer used for coastdown testing or an alternative device may be used if approved by the EPA WA COR before use.

The contractor shall monitor the drivetrain/powertrain fluid temperatures (e.g., transmission fluid, differential fluid) during the testing via data parameters delivered over the tractor electronic control unit (ECU) or vehicle data bus.

The contractor shall provide the EPA WA COR with grade data along the location of track or road where testing is performed. If the grade is constant through the length of track or road over which the tests are conducted, the contractor may instead provide this constant value. If EPA WA COR determines this value is insufficient, then the contractor upon written technical direction from the EPA WA COR shall provide the location-specific grade.

The contractor shall warm-up the vehicle for 30min-1 hour at 65mph prior to each day's testing. Warm up is not required between model/configuration changes provided that: 1) they occur on the same day as the warm-up procedure (i.e., testing performed on the next day requires a warm-up procedure); 2) the track and tires are and remain dry during testing to reduce error introduced via rolling resistance and condensation (i.e., if testing is halted due to wet weather conditions, a sufficient amount of warm up should be performed to ensure that the track surface is dry); and 3) no instrument errors have occurred (i.e., if instrumentation fails during testing, a warm-up procedure must be performed following instrumentation repair/replacement).

The contractor shall perform the test on the coastdown road that has used for the previous tests on this truck. The contractor shall perform testing at the speeds and durations as follows while recording torque and engine power OBD information:

- 10 mph – 7.5 minutes in each direction
- 20 mph – 7.5 minutes in each direction
- 30 mph – 7.5 minutes in each direction
- 50 mph – 8-10 minutes in each direction
- 70 mph – Approx 11.25 mi or 9.6 minutes in each direction.

If necessary, the contractor may perform multiple passes, likely needed for 50 mph and 70 mph runs.

### **Task 3: Wind Tunnel Evaluation of 1/8<sup>th</sup> (12.5%) Scale Class 7/8 Tractor-Trailer Combinations with and without Aerodynamic Trailer Devices**

The contractor shall conduct reduced-scale wind tunnel evaluation of 1/8<sup>th</sup> (12.5%) scale Class 7/8 Tractor-Trailer combination models with and without aerodynamic trailer devices installed, individually and in combination, to quantify the aerodynamic drag change from aerodynamic trailer devices using the test procedures and specifications described in 40 CFR Part 86.1037.521.

The contractor shall provide detailed models of 1/8<sup>th</sup> (12.5%) scale Class 7/8 Tractor-Trailers as follows: the four North American tractor OEMs (Navistar, PACCAR, Daimler, Volvo); at least three 53 foot dry box van trailer OEMs, and the following aerodynamic trailer devices; trailer skirts, aft device/Trailer Tail, and trailer front device/gap reducer. These models shall be utilized for testing in different combinations to evaluate tractor/trailer/device aerodynamics. Additional technical detail on test scenario/case set-up will be provided to the contractor by the EPA WA COR via written technical direction. The contractor shall furnish results of this task to the EPA WA COR as they become available and shall include a summary of all results from this task in the final report.

For this task, the contractor shall have access to a reduced scale wind tunnel facility meeting the requirements in 40 CFR Part 86.1037.521 to conduct wind tunnel testing; 1/8<sup>th</sup> scale models of OEM Class 7/8 tractors, 53 foot dry box van and other trailers, and aerodynamic trailer devices, either independently owned or via access through the OEMs; and capabilities and facilities to properly instrument and modify 1/8<sup>th</sup> scale models for testing. The wind tunnel facility shall have a

rolling/moving floor and boundary layer reduction devices and both shall be active during the testing in this task. In addition, the contractor shall have the ability to perform dual balance force isolation to identify the independent drag forces acting separately on the tractor and trailer, as well as the forces on the overall, combined tractor-trailer.

In addition, the contractor shall include, at a minimum, the following items in the technical report: the test process, all set-ups, test conditions including tunnel set-up, the measurement equipment and the mounting system, tractor and trailer model configuration, equipment, software used, data collection methods, descriptive photos of the baseline and all items tested with key setup elements, basic description of post processing methods and calculations, and discussion and analysis of any testing issues, if applicable. Upon written technical direction from the EPA WA COR, the contractor shall be required to perform additional discussion and/or analysis on other aspects of the testing performed under this work assignment.

If the contractor does not possess a facility or have access to this equipment, they shall notify the EPA WA COR and include the cost of acquiring this service and equipment in the work plan. Potential sources for the work under this task are available upon request. Any source considered or used shall also meet the requirements above.

Any reduced scale model tractors, trailers or components manufactured or acquired for the purpose of this work assignment will not become government property.

#### **Task 4: Quantification of Greenhouse Gas Emissions Potential from Aerodynamic Trailer Devices on Class 7/8 Tractor-Trailer Combinations**

The contractor shall input the data generated in Tasks 1, 2, and 3 into EPA's Greenhouse Gas Emissions Model (GEM) to quantify/estimate the GHG/CO<sub>2</sub> improvement from adding aerodynamic trailer devices to Class 7/8 Tractor-Trailer combinations. The EPA GEM software is publicly available at <http://www.epa.gov/otaq/climate/gem.htm#2-0-1>.

The contractor shall coordinate with and direct any question to the EPA WA COR on the process for developing the GHG emissions benefits using GEM. The contractor shall include a summary of all results from this task in the final report, including a list of the input parameters used for the GEM runs.

#### **Task 5: Cost Analysis of Aerodynamic Trailer Devices for Class 7/8 Tractor-Trailer Combinations**

The contractor shall perform a cost analysis of aerodynamic trailer devices intended for Class 7/8 Tractor-Trailer combinations. The contractor shall limit the focus of the cost analysis to the specific devices (e.g., trailer skirt, aft device/boat tail, front device/gap reducer) tested under this work assignment. Additionally, upon receipt of written technical direction from the EPA WA COR, the contractor shall expand this cost analysis to include additional devices (e.g., vortex generators, underbelly treatments, wheel covers) or devices from other manufacturers than those used for this work assignment. The contractor shall provide a basis and source for all assumptions and information collected under this task. The contractor shall include a summary of all results from this task in the final report.

The contractor shall not begin performance under this task until written technical direction is received from the EPA WA COR.

#### **Task 6: Cost-Benefit Analysis of Aerodynamic Trailer Devices for Class 7/8 Tractor-Trailer Combinations**

The contractor shall use the measured/estimated aerodynamic benefits generated in Tasks 2a, 2b, and 3, the GHG benefits estimated in Task 4, and the costs in Task 5 to produce a range of

the cost benefits of Aerodynamic Trailer Devices for Class 7/8 Tractor-Trailer Combinations following performance of those tasks and QA/QC of the data generated from each task. If data has not been generated under a task, the contractor shall perform the cost-benefit analysis using data from the tasks that have been performed.

The contractor shall use the metric of grams of CO<sub>2</sub> per ton-mile (g/CO<sub>2</sub>/ton-mile; used by EPA) to calculate all cost benefits and shall convert these values into gallons/1,000 ton-mile (gal/1,000 ton-mile; used by NHTSA) to be consistent with the metrics used previously for HD GHG Phase 1, and anticipated for use in HD GHG Phase 2. The contractor shall use assumptions, methods and processes consistent with those in HD GHG Phase 1 to perform the cost-benefit analysis performed under this task, to the extent feasible. The contractor shall include a summary of all results and a detailed description of the methodology, procedures, numerical values, rationale and any other assumptions used for this task in the final report.

The contractor shall not begin performance under this task until written technical direction is received from the EPA WA COR.

#### **IV. DELIVERABLES**

##### **1. Kick-off Meeting**

Within one week after the WA is issued, but prior to the contractor submitting a Work Plan, the contractor shall discuss this work assignment with the EPA WA COR to ensure a common understanding of the requirements, expectations, and ultimate end products.

##### **2. Develop Quality Assurance Project Plan**

The contractor shall submit a draft QAPP to the EPA WA COR within 15 days of Work Plan approval. The QAPP shall detail data collection and analysis tasks and procedures for this work assignment. The EPA WA COR shall review and comment on the draft QAPP. The contractor shall incorporate recommended changes and suggestions received from the EPA WA COR and shall submit a final QAPP within 15 days after receipt of EPA comments. Guidance can be found at: QAPP for use of existing data: <http://www.epa.gov/quality/qs-docs/found-data-qapp-rqts.pdf>; Assessment Factors for relevance, applicability, utility of existing data: <http://www.epa.gov/spc/pdfs/assess2.pdf>; and EPA Requirements for QAPPs: <http://www.epa.gov/quality/qs-docs/r5-final.pdf>.

The final QAPP shall cover all aspects of this test program as outlined on the EPA quality website. The QAPP shall have an appendix containing all applicable standard operating procedures (SOPs). The contractor shall adhere to all applicable SOPs and the QA procedures recommended therein. The contractor shall notify the EPA WA COR immediately if they encounter any equipment failures that cannot be remedied, problems that may impact the quality or on-time receipt of deliverables, or unavailability of items required for this work assignment.

##### **3. Regular Progress Reports**

The contractor shall provide the EPA WA COR with regular status reports via telephone conference or email during the period of performance. The frequency of the progress report can be adjusted as weekly or bi-weekly depending on the progress of the program. The progress report shall indicate the progress achieved in the concluded weeks, technical problems encountered, solutions to those problems, and projected activity for the upcoming weeks. Before proceeding with any solution to a problem, the contractor shall report the problem and consult with the EPA WA COR concerning the scope of the solution.

#### 4. Technical Reports

The contractor shall provide the EPA WA COR with a brief Technical Report upon completion of each task. Depending on the complexity of the subject matter and as directed via written technical direction by the EPA WA COR, these reports shall be in the form of either a presentation or a formal written document. Written products shall be delivered in formats specified by the EPA WA COR (e.g., Word, Excel).

#### 5. Data

The contractor shall provide the EPA WA COR with raw test data within 5 days of completion of the contractor's quality control review and approval for such data. The contractor shall provide to the EPA WA COR valid test data from a vehicle (per task) within 14 days of completion of the testing on the vehicle. All data shall be presented in Excel format.

#### 6. Draft and Final Reports

The contractor shall provide to the EPA WA COR a Draft Final Report and data set summarizing the results of all tasks within 30 days of completion of the laboratory and modeling work contained in this work assignment. The contractor shall deliver the Final Report within 15 days of receipt of comments from the EPA WA COR. All reports and associated materials (e.g., data sets) shall be provided in formats specified by the EPA WA COR.

### **Schedule of Deliverables**

Deliverable	Completion Date
Kick-off Meeting (as necessary based on direction from the EPA WA COR)	Within 1 week of receipt of work assignment
QAPP submission	Within 15 days of receipt of Work Plan approval
Final QAPP	Within 15 days of receiving EPA comments
Complete Tasks 1 ,2	Before September 30, 2014
Complete Task 3	Before August 31, 2014
Complete Tasks 4, 5, & 6	Before September 30, 2014
Draft Final Report	Within 30 days of completion of all tasks
Final Report	Within 15 days of receipt of EPA comments on Draft Final Report

#### NON-DISCLOSURE AGREEMENT

All documentation acquired and/or provided by EPA or generated as a result of this project shall be under the control of the U.S. EPA Assistant Administrator for Air and Radiation, or his or her designated representative, and shall not be released by the contractor to any other source without specific approval by U.S. EPA.

<b>EPA</b> United States Environmental Protection Agency Washington, DC 20460 <b>Work Assignment</b>						Work Assignment Number 3-05				
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:				
Contract Number EP-C-12-011			Contract Period 02/01/2012 To 09/30/2015			Title of Work Assignment/SF Site Name				
			Base                      Option Period Number    3			GHG Transportation Inventory				
Contractor ICF Incorporated, L.L.C.					Specify Section and paragraph of Contract SOW Task 7a					
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval					Period of Performance  From 10/01/2014 To 09/30/2015					
Comments:										
<input type="checkbox"/> Superfund                      Accounting and Appropriations Data <input checked="" type="checkbox"/> Non-Superfund										
SFO (Max 2) <input type="checkbox"/> Note: To report additional accounting and appropriations date use EPA Form 1900-69A.										
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										
Authorized Work Assignment Ceiling										
Contract Period:		Cost/Fee:			LOE:					
02/01/2012 To 09/30/2015										
This Action:										
Total:										
Work Plan / Cost Estimate Approvals										
Contractor WP Dated:				Cost/Fee:			LOE:			
Cumulative Approved:				Cost/Fee:			LOE:			
Work Assignment Manager Name Sarah Froman							Branch/Mail Code:			
_____ (Signature)                      (Date)							Phone Number 202-343-9652			
							FAX Number:			
Project Officer Name Greg Janssen							Branch/Mail Code:			
_____ (Signature)                      (Date)							Phone Number: 734-214-4285			
							FAX Number: 734-214-4821			
Other Agency Official Name Jose Ortiz							Branch/Mail Code:			
_____ (Signature)                      (Date)							Phone Number: 513-487-2831			
							FAX Number: 513-487-2109			
Contracting Official Name Sandra Savage							Branch/Mail Code:			
_____ (Signature)                      (Date)							Phone Number: 513-487-2046			
							FAX Number:			



## **PERFORMANCE WORK STATEMENT**

EPA Contract: EP-C-12-011

Work Assignment (WA): 3-05

Issuing Office: US Environmental Protection Agency  
Office of Transportation and Air Quality (OTAQ)  
2000 Traverwood Dr.  
Ann Arbor, Michigan 48105

Contractor: ICF International  
9300 Lee Highway  
Fairfax, VA 22031-1207

Statement of Work: GHG Transportation Inventory Development

Period of Performance: October 1, 2014 – September 30, 2015

Work Assignment Contracting Officer Representative (WA COR):  
Sarah Froman  
202-343-9652  
froman.sarah@epa.gov

Alternate WA COR: Amy Bunker  
734-214-4160  
bunker.amy@epa.gov

### **BACKGROUND**

The transportation sector is responsible for roughly 30 percent of greenhouse gas (GHG) emissions in the U.S., as well as the production of smog precursors, carbon monoxide (CO) and air toxics. Other impacts from transportation include noise and ecosystem disturbance. These effects are acknowledged through national legislation and other commitments, including:

- National Environmental Protection Act of 1969 (NEPA)
- Clean Air Act (CAA) Amendments of 1990
- Intermodal Surface Transportation Act of 1991 (ISTEA)
- Transportation Equity Act for the 21st Century (TEA-21)
- Climate Change Action Plan of 1993 (CCAP) and
- 1993 United Nations Framework Convention on Climate Change (UNFCCC).

EPA supports a range of analytic functions to demonstrate the environmental impacts of transportation. The UNFCCC requires that the U.S., with lead responsibility by EPA, report to the United Nations all U.S. emissions and sinks of GHGs. By mutual agreement with the Office of Atmospheric Programs (OAP), the Office of Transportation and Air Quality (OTAQ) has assumed responsibility for preparing estimates of GHG emissions for the transportation sector. Within OTAQ, the Transportation and Climate Division (TCD) manages this analysis. TCD also supports EPA programs by examining the intersection of transportation policy, travel demand, vehicle engine technologies and energy consumption. Finally, TCD assists OTAQ and EPA in providing data and analysis to address the information requests of Congress, the Executive Branch, and the public.



## **WORK OVERVIEW**

TCD's analytic work addresses the environmental impacts of transportation programs, policies and investments at all levels of government. This effort enhances the technical capacity of stakeholders in the fields of climate change analysis, air quality management, and transportation and urban planning.

TCD's analysis of transportation and climate change includes the development of an emissions inventory that identifies and quantifies the primary anthropogenic sources and sinks of U.S. GHG emissions from transportation sources. The GHG transportation inventory must contain: (1) a comprehensive and detailed methodology for estimating sources and sinks of anthropogenic GHG emissions at levels sufficiently detailed to support policy decisions; and (2) represent a common and consistent source of information enabling OTAQ to compare the relative contribution of different GHG emission sources to climate change. The ability to estimate emissions systematically and consistently is a prerequisite for evaluating the cost-effectiveness and feasibility of GHG mitigation strategies.

### **Task 1: 2013 Expert Review Report**

The Contractor shall complete the draft of the 1990-2013 GHG emission inventory from the transportation sector for the draft *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013* report ("2013 Expert Review report").

The Contractor shall build upon the work already conducted under WA 2-05 to develop the draft transportation GHG emissions inventory for the 2013 Expert Review report, improving on the estimation and documentation associated with both annual emission estimates and emission trends for the transportation inventory as directed by the WA COR. The inventory shall include estimates of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrogen dioxide (N<sub>2</sub>O) and hydrofluorocarbons (HFC) emissions from all mobile sources, including highway vehicles, aircraft, rail, watercraft, and non-road mobile sources. The inventory shall also include emissions of the following criteria pollutants: CO, NO<sub>x</sub>, VOCs, and sulfur dioxide (SO<sub>2</sub>); estimates of these gases are to be obtained from the Office of Air Quality Planning and Standards (OAQPS).

This task shall include performance of Quality Assurance and Quality Control (QA/QC), but not uncertainty analyses.

The Contractor shall report transportation GHG data in accordance with the schedule and formats necessary to complete the 2013 Expert Review report as defined through written technical direction by the WA COR. The Contractor shall receive approval from the WA COR prior to submitting any transportation-related data to OAP.

### **Task 2: 2013 Public Review and Final Reports**

The Contractor shall prepare the annual GHG emission inventory from the transportation sector for the public review and final versions of the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013* document ("2013 Public Review and Final reports"). The inventory shall include estimates of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), Nitrogen Dioxide (N<sub>2</sub>O) and hydrofluorocarbons (HFC) emissions from all mobile sources, including highway vehicles, aircraft, rail, watercraft, and non-road mobile sources. The inventory shall also include emissions of the following criteria pollutants: CO, NO<sub>x</sub>, VOCs, and sulfur dioxide (SO<sub>2</sub>); estimates of these gases are to be obtained from the Office of Air Quality Planning and Standards (OAQPS).

The Contractor shall build upon the work already conducted under Task 1, improving on the estimation and documentation associated with both annual emission estimates and emission trends for the transportation inventory as provided in written technical direction by the WA

COR. This task shall include all additional work necessary to complete the Public Review and Final reports, including addressing expert review comments and public review comments. This task shall also include performance of QA/QC and uncertainty analyses.

The Contractor shall report transportation GHG data in accordance with the schedule and formats necessary to complete the 2013 Public Review and Final reports as defined through written technical direction by the WA COR. The Contractor shall receive approval from the WA COR prior to submitting any transportation-related data to OAP.

The WA COR will provide the Contractor with the guidance regarding uncertainty analysis; QA/QC activities; and requirements for documentation, spreadsheet management, annexes, work breakdown structure (WBS), and report write-up.

### **Task 3: Novel Inventory Improvements**

The GHG Inventory shall be updated and improved to reflect new datasets, new methodologies, and new tools that better capture and describe the transportation emissions inventory. Under this task, the Contractor shall provide analysis, research, and reports that support improvements to the documentation, tracking, error-checking, data and methodology that are not a part of routine improvements conducted under Tasks 1, 2, and 5. The Contractor shall provide an estimated level of effort for multiple improvements at the technical direction of the WA COR. As specific needs may evolve within the period of the contract, the WA COR will provide written technical direction for each report, prior to the Contractor commencing work.

### **Task 4: Inputs to Fast Facts and Other Educational Materials**

In conjunction with preparation of the final report in Task 2, the Contractor shall prepare data for a summary report, "2013 Fast Facts", to be released publicly which summarizes emissions from transportation sector. The data for the "2013 Fast Facts" shall be prepared in a similar fashion to the data provided under WA 2-05 for the "2012 Fast Facts" (called the 2014 Fast Facts document under WA 2-05). The summary data shall convey the highlights from the current year's inventory in sufficient detail to be used by policymakers in OTAQ, while also be understood by the general public. The Contractor shall review the draft 2013 Fast Facts. The Contractor shall also prepare data to support other educational materials, such as a slide presentation overview of inventory methods and one-page factsheets on inventory estimates and data for two or three individual transportation sectors, as needed, per written technical direction from the WA COR.

### **Task 5: 2014 Expert Review Report**

The Contractor shall prepare a draft of the 1990-2014 GHG emission inventory from the transportation sector for the draft *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014* report ("2014 Expert Review report").

The Contractor shall build upon the work conducted under Task 2, improving on the estimation and documentation associated with both annual emission estimates and emission trends for the transportation inventory as provided in written technical direction by the WA COR. The inventory shall include estimates of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrogen dioxide (N<sub>2</sub>O) and hydrofluorocarbons (HFC) emissions from all mobile sources, including highway vehicles, aircraft, rail, watercraft, and non-road mobile sources. The inventory shall also include emissions of the following criteria pollutants: CO, NO<sub>x</sub>, VOCs, and sulfur dioxide (SO<sub>2</sub>); estimates of these gases are to be obtained from the Office of Air Quality Planning and Standards (OAQPS).

This task shall include performance of Quality Assurance and Quality Control (QA/QC), but not uncertainty analyses.

## QUALITY ASSURANCE (QA) REQUIREMENTS

The Contractor shall submit a written Quality Assurance (QA) Project Plan that describes the quality assurance procedures, quality control specifications, and other technical activities that must be implemented to ensure that the results of the project or task to be performed.

Alternatively, the contractor can submit a Quality Assurance Supplement to their Quality Management Plan that includes all the required information for a QA Project Plan.

## DOCUMENTATION

The Contractor shall fully substantiate and document all of its work. No work shall be duplicated under this contract. In order to avoid duplication of effort, the Contractor shall always investigate existing literature and consult with the EPA WA COR about any information the agency may have or know about prior to undertaking any market research activities. Reports submitted by the Contractor that contain recommendations to EPA shall explain and rank policy or action alternatives, describe the procedure used to arrive at recommendations, summarize the substance of deliberations, report any dissenting views, list the sources used, and make clear the methods and considerations upon which the recommendations are based.

## DISTRIBUTION AND FORMAT OF DELIVERABLES

The Contractor shall deliver all work assignment deliverables, including status reports and interim products, in an appropriate electronic format (e.g., Microsoft Word, Excel, and Acrobat). This applies to all tasks under this work assignment unless otherwise specified in written technical direction by the WA COR.

## DELIVERABLES

The schedule for deliverables may be adjusted through written technical direction from the WA COR.

Task	Deliverable	Schedule
	<u>Kick-off Meeting</u> : The WA COR and Contractor shall meet to discuss the tasks within the workplan.	Within one week of approval of workplan.
	<u>Biweekly Progress Reports</u> : In addition to the monthly progress reports, the WA COR and the Contractor shall contact each other to ensure that adequate progress is being made on all tasks.	At least once every other week.
	<u>Responding to EPA Questions</u> : The Contractor shall respond to EPA technical questions related to the tasks via email and phone.	As needed, per technical direction from WA COR.
1	<u>2013 Expert Review report</u> : The Contractor shall provide the WA COR with all the material – including spreadsheets, supplemental analysis, and text - required for the transportation component of the of the 2013 Expert Review report.	October 25, 2014
2	<u>2013 Public Review report spreadsheets</u> : The Contractor shall provide the WA COR with draft spreadsheets and any supplemental analyses conducted in support of the transportation component of the 2013 Public Review report.	January 12, 2015

<b>2</b>	<u>2013 Public Review report text:</u> The Contractor shall provide the WA COR with draft documents and text sections in support of the transportation component of the 2013 Public Review report.	January 26, 2015
<b>2</b>	<u>2013 Final Report spreadsheets:</u> The Contractor shall provide the WA COR with draft spreadsheets and any supplemental analyses conducted in support of the transportation component of the Final report.	March 23, 2015
<b>2</b>	<u>2013 Final Report text:</u> The Contractor shall provide the WA COR with draft documents and text sections in support of the transportation component of the 2013 Final report.	March 30, 2015
<b>3</b>	<u>Inventory Improvements Meeting and Memo:</u> The WA COR and Contractor shall meet to discuss initiating improvements for next year's inventory. In preparation for this meeting, the Contractor shall update the Inventory Improvements Memo completed under WA 2-05 with additional improvements identified during this year's inventory preparation and estimate the associated level of effort as well as the relative utility for inventory users.	After completion of Task 2, per technical direction from WA COR.
<b>3</b>	<u>Other Novel Inventory Improvements:</u> The Contractor shall provide an estimated level of effort for additional improvements not initially identified in the Inventory Improvements Memo.	As needed, per technical direction from WA COR.
<b>4</b>	<u>Input to Fast Facts and Review</u>	After completion of Task 2, per technical direction from WA COR.
<b>4</b>	<u>Input to Other Educational Materials</u>	As needed, per technical direction from WA COR.
<b>5</b>	<u>2014 Expert Review report spreadsheets:</u> The Contractor shall provide the WA COR with draft spreadsheets and any supplemental analyses conducted in support of the transportation component of the 2014 Expert Review report.	September 11, 2015
<b>5</b>	<u>2014 Expert Review report text:</u> The Contractor shall provide the WA COR with draft documents and text sections in support of the transportation component of the 2014 Expert Review report.	September 25, 2015

<b>EPA</b> United States Environmental Protection Agency Washington, DC 20460 <b>Work Assignment</b>						Work Assignment Number 3-06			
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:			
Contract Number EP-C-12-011		Contract Period   02/01/2012   To   09/30/2015 Base                      Option Period Number      3		Title of Work Assignment/SF Site Name Inland Port Community Transpor					
Contractor ICF INCORPORATED, L.L.C.				Specify Section and paragraph of Contract SOW Tasks 7a, 2, 3, 4, 5, 12					
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval						Period of Performance  From   01/29/2015   To   09/30/2015			
Comments:									
<input type="checkbox"/> Superfund    Accounting and Appropriations Data <input checked="" type="checkbox"/> Non-Superfund									
Note: To report additional accounting and appropriations date use EPA Form 1900-69A.									
SFO <input type="checkbox"/> (Max 2)									
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)  (Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1									
2									
3									
4									
5									
Authorized Work Assignment Ceiling									
Contract Period:		Cost/Fee:		LOE:					
02/01/2012   To   09/30/2015									
This Action:									
Total:									
Work Plan / Cost Estimate Approvals									
Contractor WP Dated:		Cost/Fee:		LOE:					
Cumulative Approved:		Cost/Fee:		LOE:					
Work Assignment Manager Name    Melissa Mccullough  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>						Branch/Mail Code: Phone Number    919-541-5646 FAX Number:			
Project Officer Name    Greg Janssen  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>						Branch/Mail Code: Phone Number:    734-214-4285 FAX Number:    734-214-4821			
Other Agency Official Name    Jose Ortiz  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>						Branch/Mail Code: Phone Number:    513-487-2831 FAX Number:    513-487-2109			
Contracting Official Name    Sandra Savage  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>						Branch/Mail Code: Phone Number:    513-487-2046 FAX Number:			

## **PERFORMANCE WORK STATEMENT**

**EPA Contract:** EP-C-12-011

**Contractor:** ICF

**Work Assignment:** WA 3-06

**Title:** Inland Port Community Transportation Resilience Analysis in Mississippi-Tennessee-Arkansas

**Estimated Period of Performance:** Initiation to September 30, 2015

**Work Assignment Contracting Officer Representative (WA COR):**  
Melissa McCullough  
ORD, Sustainable & Healthy Communities Program  
U.S. EPA Immediate Office  
(919) 541-5646  
mccullough.melissa@epa.gov

**Alternate WA COR:**  
Richard Baldauf  
ORD, National Risk Management Laboratory  
Air Pollution Prevention and Control Division  
Emissions Characterization and Prevention Branch  
(919) 541-4386  
baldauf.richard@epa.gov

**Contract Level COR:**  
Greg Janssen  
Office of Transportation and Air Quality (OTAQ)  
Assessment and Standards Division  
(734) 214-4285  
janssen.greg@epa.gov

## **BACKGROUND**

More than 25,000 miles of the nation's inland waterways are transporting millions of tons of cargo every day. The inland waterway transportation system is used to transport approximately 20% of the nation's coal, 22% of U.S. petroleum, and more than 60% of the nation's farm exports. Because much of the cargo shipped by barge is used as raw materials for other industries, disruptions in barge transportation results in production disruptions and economic losses throughout the country.<sup>1</sup> The inland ports are anticipating a greater flow of goods through waterways once the Panama Canal expansion is complete in 2014 (believed to be from an increase of agricultural exports although there has not been a documented assessment).

The tri-city regional area of Memphis-West Memphis-DeSoto County is a transportation and logistics hub for the region. The City of Memphis has tremendous logistics and shipping reach and access through rail, air freight, roads, and river. West Memphis began its role as a trucking hub with the opening of parts of I-55 with major interstates

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<sup>1</sup> [www.mackblackwell.org/NTSCOE\\_Communicator\\_August\\_2011.pdf](http://www.mackblackwell.org/NTSCOE_Communicator_August_2011.pdf)

traveling toward the Mississippi River. DeSoto County is home to I-95 truck terminals and houses rail systems that serve intermodal yards in Memphis and West Memphis.

The 2011-2013 flooding and drought cycles on the Mississippi River severely curtailed barge traffic, which had a significant economic impact on the barge services, shipping, and agricultural industries. Rerouting disrupted cargo without overwhelming an already congested highway and rail system presents a significant challenge.<sup>2</sup> The American Waterways Operators estimates that transporting goods via waterways costs \$11/ton less than by rail or truck. The economic costs that come from shipping delays and lighter loads could eventually trickle down to consumers. Being a transportation and logistics hub also has contributed to the tri-cities being designated a "marginal" non-attainment area for the 2008 Ozone National Ambient Air Quality Standards, while Memphis has a history of non-attainment dating back to 2004.<sup>3</sup>

This project addresses research needs and assessment tool development for inland ports with multimodal transportation options, which are susceptible to more frequent emergency weather impacts. This work will also be applicable to coastal port communities facing similar challenges. Key elements include: (1) identifying public health impacts from shifting intermodal transportation contributing to air emissions that impact regional and local air quality (2) assessing the economic costs to communities of shifting freight transportation choices; and, (3) determining how port communities can be more resilient<sup>4</sup> in the face of multimodal transportation disruptions<sup>5</sup>. This project will be conducted for the port cities of Memphis, West Memphis, and the city of Hernando in DeSoto County.

Research with the communities in the tri-city port area will inform the development of an in-land port community resilience decision roadmap that helps prioritize inter-modal shipping, emissions, business efficiency, and community health needs. The assessment and tool development work that would be completed would be transferable to other inland and coastal working waterfront communities to help mitigate potential health, environmental, and economic impacts. The proposal addresses the following ORD Sustainable and Healthy Communities Research Program (SHCRP) research areas: 1) Data and tools to support community decisions; 2) Forecasting and assessing ecological and community health; and, 3) Integrated solutions for sustainable outcomes in specific communities. In addition, the project provides the necessary translation between ORD sustainability research to direct application that provides environmental, social, and economic benefits to communities.

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<sup>2</sup> Ibid

<sup>3</sup> <http://www.bizjournals.com/memphis/news/2012/12/20/shelby-countys-non-attainment-epa.html?page=all>

<sup>4</sup> The definition of community resilience is the sustained ability of a community to withstand and recover from adversity (e.g., economic stress, public health pandemics, man-made or natural disasters). Community resilience entails the ongoing and developing capacity of the community to account for its vulnerabilities and develop capabilities that aid that community in (1) preventing, withstanding, and mitigating a stress or stressors; (2) recovering in a way that restores the community to a state of self-sufficiency and at least the same level of economic, environmental and public health and social functioning; and (3) using knowledge from a past response to strengthen the community's ability to withstand future incidents. While there is general consensus on the definition of resilience, there is less clarity on the precise roadmap to assess existing communities' vulnerabilities, and therefore predict their response to the resilience-building process. In other words, we have limited understanding about the components that can be changed or the "levers" for action that enable communities to recover more quickly.

<sup>5</sup> NOAA has a Port Resilience tool, but it does not deal with the variability faced by in-land ports. <http://www.csc.noaa.gov/port/>



## **QUALITY ASSURANCE (QA) REQUIREMENTS**

The contractor shall submit a written Quality Assurance Project Plan (QAPP). The contractor may utilize the draft QAPP submitted under WA 2-06 and update as necessary by the requirements of this WA 3-06. The EPA will review the QAPP and, if necessary, provide comments to the contractor. The contractor shall incorporate any revisions required after EPA review and submit a final QAPP within 15 days of receipt of EPA comments.

## **TASKS**

The WA COR will review all deliverables in draft form and provide revisions and/or comments to the contractor. The contractor shall prepare the final deliverables incorporating the WA COR's comments.

Contractor personnel shall at all times identify themselves as Contractor employees and shall not present themselves as EPA employees. Furthermore, they shall not represent the views of the U.S. Government, EPA, or its employees. In addition, the Contractor shall not engage in inherently governmental activities, including but not limited to actual determination of EPA policy and preparation of documents on EPA letterhead.

### **Task 1: Recommend and evaluate models that assess community environmental, health, and economic needs during multi-modal transportation shifts at inland ports**

The contractor shall work with the EPA WA COR to develop a list of models currently available to assess community environmental health and economic needs that involve shifts in multi-modal freight transit, especially relevant to inland ports. The models shall be capable of including the collection of existing data on transportation shifts during drought and floods on the Mississippi River. In consultation with EPA, the contractor shall determine the temporal context for this analysis (e.g., look at floods/droughts over last ten years or include more historical data). The primary transportation shifts would be from tugboats and barges to overland freight including loading dock equipment, trucks, and rail. Some existing data and resources that the contractor shall consider in the initial analysis include:

- A. The University of Arkansas and Rutgers University--The prototype decision support system will integrate GIS technology and computer based freight movement models to identify what cargoes should be prioritized for offloading during disruptions and what infrastructure exhibits low resiliency in terms of modal capacity to respond to disasters.
- B. NOAA Port Resilience tool—Coastal ports tool that does not have information on in-land ports, and specifically does not address the inter-modal variability effects on in-land port communities. The roadmap they have developed can inform the work conducted under this project and vice-versa.
- C. RIT and University of Delaware---Developing GIFT, develop a GIS-based tool to evaluate the energy, emission, cost, and time-of-delivery attributes of intermodal freight transport.<sup>6</sup> Existing tools will include, but not be limited to, CPORT, CCAT, EnviroAtlas and the Green Communities Framework.

The contractor submitted a draft summary report evaluating models to the EPA WA COR

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<sup>6</sup> GIFT - Geospatial Intermodal Freight Transportation (<http://www.rit.edu/gccis/lecdm/gift2.php>)



under WA 2-06. In continuation of that effort, the EPA WA COR will arrange up to 2 meetings (via teleconference or webinar) with contractor staff and EPA team members to review the draft of existing data resources and discuss revisions needed.

The contractor shall complete and report on the analysis of reviewed models within 20 working days of the final teleconference or webinar meeting with the EPA WA COR and EPA staff. The report shall be submitted as a Word document. The contractor may suggest whether another format is the best presentation format for the information. The EPA WA COR will provide written technical direction if another format is deemed acceptable. The final analysis shall be provided to the WA COR as a written report after 7 working days of receipt of comments.

### **Task 2: Assess Air Emissions and Exposure Pathway for Sensitive Populations in Inland Port Cities**

The contractor shall examine existing air emissions modeling data and tools and refine them as needed to evaluate relative risks to sensitive populations along heavily traveled transportation routes from the inland ports out through the tri-city area. The contractor shall evaluate and refine the models and tools based on estimated impacts from multi-modal transportation shifts from barge to overland freight options. These shifts shall be based on predictive weather data for floods and droughts for this regional area. The contractor shall consider the following tools (but not limited to):

- A. Texas Transportation Institute—Domestic freight analysis on emissions data for the relative transportation modes.
- B. EPA 2009 research—Infra-red sensing of fugitive emissions by petrochemical barges in the tri-city port area
- C. Region 4 RARE Project—port emissions data from Charleston can be modified and applied here to extrapolate truck emissions for the inland ports in the tri-city area.

The contractor shall develop a draft outline for assessing the existing modeling data and tools. The Contractor shall submit this draft outline to the EPA WA COR within 14 working days of completing Task 2 (or upon initiating Task 3), whichever occurs first.

The contractor shall complete a preliminary model/tool refinement within 60 working days of receiving comments from the EPA WA COR on the draft outline. The final model/tool refinement analysis shall be provided to the EPA WA COR after 10 working days of receipt of EPA comments from the EPA WA COR.

### **Task 3: Conduct an Inland Ports Community Needs Assessment**

The contractor shall work with the EPA WA COR and staff to set up and conduct a community needs assessment with at least one port community in the tri-city regional shipping area. With consultation and input from the contractor, the EPA WA COR will provide written technical direction to the contractor with the name of the appropriate community for this work and the appropriate stakeholders to engage in this effort. The community needs assessment shall include relevant stakeholders (e.g., shipping companies, elected officials, nonprofit groups, community leaders, etc.). The contractor shall also identify the following in the community needs assessment:

- (a) Existing challenges during times of drought/flooding related to health, economic, and community disruptions;

- (b) Community priorities and future development plans related to multi-modal transportation; and
- (c) Potential opportunities to help businesses and communities evaluate how to adapt to future changes more efficiently and minimize threats to public health and the environment.

During this needs assessment, the contractor shall share the data and information collected under Tasks 2 and 3. The EPA WA COR shall provide the contractor with a selection of the community and relevant stakeholders for the needs assessment. The EPA WA COR and the contractor shall hold up to three conference calls with the identified community to complete the needs assessment. The EPA WA COR will work with additional EPA staff and outside stakeholders to identify appropriate additional stakeholders to participate in the needs assessment. The contractor shall travel to the community and complete the needs assessment; this travel shall not last more than 3 days. In accordance with contract terms, the contractor shall seek approval from the EPA Contract-Level COR prior to any travel contemplated as a result of this task.

Within 20 working days of the needs assessment site visit, the contractor shall submit a draft of the Needs Assessment Report to the EPA WA COR for review and comment. Upon receipt of the EPA WA COR's comments, the contractor shall provide the final Needs Assessment Report within 15 working days to the EPA WA COR.

#### **Task 4—Formulate a Roadmap for Inland Ports Resiliency**

The contractor shall prepare a roadmap for inland ports that looks at resilience to severe weather and climate change. The analysis shall take into account the community needs assessment and the public health, environmental, and economic effects of disruptions or increases to multi-modal freight transportation in inland communities. The contractor shall identify existing tools and data that can inform the community resilience decision roadmap outline steps that port communities can take to be more resilient to changes in freight shipping modes and that utilize community input and other resources to be more efficient.

Within 60 working days of completion of Task 4, the contractor shall provide the EPA WA COR with a draft inland ports resilience roadmap as a Word document. The contractor may suggest whether another format is the best presentation format for the information. The EPA WA COR will provide written technical direction if another format is deemed acceptable. Within 15 working days of the receipt of comments from the EPA WA COR, the contractor shall provide a final inland ports resilience roadmap.

**SUMMARY OF ACTIVITIES, DELIVERABLES AND SCHEDULE:**

<b>Task</b>	<b>Activity</b>	<b>Schedule</b>
Task 1	Up to 2 meetings (via teleconference, or webinar) with contractor and EPA staff to review existing data resources and discuss factors to be included in the Task 2 analysis.	15 working days after kick-off meeting
	<b>Report on the preliminary analysis of reviewed models</b>	20 working days after final meeting
	EPA comments on draft analysis of reviewed models	15 working days after receipt of draft report
	<b>Final report of the model analysis</b>	10 working days after receipt of EPA comments
Task 2	<b>Draft outline for assessing the existing modeling data and tools</b>	15 working days after completion of Task 2
	EPA comments on draft outline	15 working days after receipt of draft outline
	<b>Preliminary model/tool refinement analysis</b>	60 working days after receipt of EPA comments
	EPA comments on draft model/tool refinement analysis	15 working days after receipt of draft analysis
	<b>Final model/tool refinement analysis</b>	10 working days after receipt of EPA comments
Task 3	EPA will provide the contractor with a selection of the community and relevant stakeholders for the needs assessment	20 working days after completion of Task 2
	Up to three conference calls with the contractor and identified community participants to aid in the completion of the needs assessment	15 working days after completion of community selection
	Contractor travel to community and complete the needs assessment	30 working days after completion of community conference calls
	<b>Draft needs assessment report</b>	20 working days after completion of the needs assessment site visit
	EPA comments on draft needs assessment report	15 working days after receipt of draft needs assessment report
	<b>Final needs assessment report</b>	15 working days after receipt of EPA comments
Task 4	<b>Draft inland ports resilience roadmap</b>	<b>30 working days after completion of Task 4</b>
	EPA comments on draft inland ports resilience roadmap	15 working days after receipt of draft roadmap
	<b>Final inland ports resilience roadmap</b>	<b>15 working days after receipt of EPA comments</b>

<b>EPA</b> United States Environmental Protection Agency Washington, DC 20460 <b>Work Assignment</b>						Work Assignment Number 3-07			
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:			
Contract Number EP-C-12-011		Contract Period   02/01/2012   To   09/30/2015 Base                      Option Period Number       3		Title of Work Assignment/SF Site Name Peer Review Support Moves2014					
Contractor ICF INCORPORATED, L.L.C.				Specify Section and paragraph of Contract SOW Tasks 2, 3, 4, 7, and 11					
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval						Period of Performance  From   03/19/2015   To   09/30/2015			
Comments:									
<input type="checkbox"/> Superfund                      Accounting and Appropriations Data <input checked="" type="checkbox"/> Non-Superfund									
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.									
SFO <input type="checkbox"/> (Max 2)									
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)  (Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1									
2									
3									
4									
5									
Authorized Work Assignment Ceiling									
Contract Period:		Cost/Fee:		LOE:					
02/01/2012   To   09/30/2015									
This Action:									
Total:									
Work Plan / Cost Estimate Approvals									
Contractor WP Dated:				Cost/Fee:		LOE:			
Cumulative Approved:				Cost/Fee:		LOE:			
Work Assignment Manager Name    Kent Helmer  <div style="display: flex; justify-content: space-between; border-top: 1px solid black; margin-top: 10px;"> <span>(Signature)</span> <span>(Date)</span> </div>						Branch/Mail Code:			
						Phone Number    734-214-4825			
						FAX Number:    734-214-4821			
Project Officer Name    Greg Janssen  <div style="display: flex; justify-content: space-between; border-top: 1px solid black; margin-top: 10px;"> <span>(Signature)</span> <span>(Date)</span> </div>						Branch/Mail Code:			
						Phone Number:    734-214-4285			
						FAX Number:    734-214-4821			
Other Agency Official Name  <div style="display: flex; justify-content: space-between; border-top: 1px solid black; margin-top: 10px;"> <span>(Signature)</span> <span>(Date)</span> </div>						Branch/Mail Code:			
						Phone Number:			
						FAX Number:			
Contracting Official Name    Sandra Savage  <div style="display: flex; justify-content: space-between; border-top: 1px solid black; margin-top: 10px;"> <span>(Signature)</span> <span>(Date)</span> </div>						Branch/Mail Code:			
						Phone Number:    513-487-2046			
						FAX Number:			

**PERFORMANCE WORK STATEMENT**

Issuing Office: US Environmental Protection Agency

Contractor: ICF International  
9300 Lee Highway  
Fairfax, VA 22031-1207

Title: Peer Review Support for MOVES2014 & C3 Marine Inventory

Work Assignment Contracting  
Officer Representative (WA COR): Kent Helmer, ASD-S89  
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Ann Arbor, MI 48105  
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Fax: 734-214-4821  
Email: [helmer.kent@epa.gov](mailto:helmer.kent@epa.gov)

Alternate WA COR: Harvey Michaels, ASD-S94  
2000 Traverwood Drive  
Ann Arbor, MI 48105  
Tel: 734-214-184  
Fax: 734-214-4821  
Email: [michaels.harvey@epa.gov](mailto:michaels.harvey@epa.gov)

Period of Performance: March 19, 2015 – September 30, 2015

**BACKGROUND**

As new policy options are brought forth, there is a need to evaluate the soundness and utility of such policies. Modeling questions may yield approximations from smaller sets of real data when questions of policy tend to be too large to study directly. For example, models can provide insights into how drivers will change their vehicle operating patterns in response to a mandated increase in fuel economy across the light-duty vehicle (LDV) fleet. EPA's MOVES2014 model is part of a comprehensive EPA approach to address the impacts of light- and heavy-duty vehicles on air quality and public health.

While all of the reports/analyses referenced here for peer review document the result of various inquiries into the nature of fuels and engine exhaust and evaporative emission interactions on air quality, only three of the four directly relate back to LDV emissions. These LDV emissions reports/studies detail how EPA intends to update its ability to model in MOVES2014 policy outcomes from proposed changes to our understanding of the US vehicle fleet and to help mitigate any adverse air quality impacts associated with future motor vehicle fuels.

The fourth study uses a large, ocean-going (C3) commercial marine vessel model, GAMS, to estimate yearly fuel demand in these vessels by summing up the individual fuel consumption rates of all the vessels under consideration. Fuel demand numbers will then be used to develop estimates of the C3 marine vessel emission contribution, “inventory”, to air quality in general.

### **SCOPE**

This effort supports EPA by having a contractor facilitate independent peer reviews of the four studies/reports cited below:

- Vehicle Population and Activity Update Report, a.k.a. “Fleets Report”;
- Speciation Profiles and Toxic Emission Factors for Nonroad Engines, a.k.a. “Toxics Report”;
- C3 Commercial Marine Bunker Fuel Demand Update, a.k.a. “C3 Marine Report”; and
- MOVES2014 Validation Study, a.k.a. “Validation Report”.

The report and any supporting documentation are expected to be available for distribution to reviewers on or after March 1<sup>st</sup>, 2015.

All documents either for review or to support the study under review shall be treated as confidential information and are to stay within the knowledge of the contractor, the peer reviewers, and EPA staff. Authorization should be sought through the Work Assignment Contracting Officer Representative (WA COR) to discuss the material outside of the context of the peer review.

### **TASKS**

The contractor shall select peer reviewers and facilitate their review and comment on EPA’s interim Toxics and Fleets reports and MOVES validation study, supporting EPA’s MOVES2014 model release, and EPA’s bunker fuel demand update supporting EPA’s C3 marine emission inventory efforts.

Along with facilitating the peer review process, the contractor shall be familiar with the provisions of the Peer Review Handbook to ensure that EPA’s peer review guidelines are met. These guidelines, EPA’s Science Policy Council Peer Review Handbook, 3<sup>rd</sup> Ed., can be found at <http://www.epa.gov/peerreview/>. Further, OMB’s Information Quality Bulletin for Peer Review and Preamble (found in the EPA’s Peer Review Handbook, Appendix B) contains provisions for the conduct of peer reviews across federal agencies and may serve as an overview of EPA’s peer review process and principles.

#### **Task 1. Selection of Peer Reviewer Candidates**

The contractor shall select **two** qualified subject matter experts for each of the four reports cited above. Each of the potential peer reviewers must be independent. EPA defines an “independent peer reviewer” as an expert who was not associated with the generation of the specific work

product either directly by substantial contribution to its development or indirectly by significant consultation during the development of the specific product. The independent peer reviewer, thus, is expected to be objective (for further information, see Sections 1.2.6 and 1.2.7 of EPA's Peer Review Handbook).

The contractor shall send to the WA COR a list of the names and affiliations of the proposed peer reviewers, each candidate's curriculum vitae or resume and a target start date for each person's peer review. In selecting reviewer candidates, the Contractor shall avoid those with actual or apparent conflict(s)-of-interest that would preclude an independent review. Sections 3.4.5 and 3.4.6 of the Handbook can be referenced for avoidance of conflict(s) of interest. The contractor shall select reviewers from a variety of fields such that all of the technical aspects of each report will be professionally reviewed.

The documentation to be reviewed for each product contributing to EPA's MOVES2014 update shall consist of between 30 and 60 pages of material. It is anticipated that each peer reviewer will spend approximately 15 hours in analysis of the data, assumptions and conclusions, and in writing their response.

For the C3 Marine Report, the documentation to be reviewed shall consist of approximately 60 pages of material. It is anticipated that each peer reviewer will spend between 15 and 20 hours in analysis of the data, assumptions and conclusions, and in writing their response.

A partial list of known subject matter experts from academia and industry (see Appendix A, following) has been included as a suggested starting point from which to identify the candidates to participate in each peer review. The list shall not limit the contractor in the identification of potential reviewers but should serve as a "jumping-off point" to begin the search for reviewers.

The contractor shall contact subject matter experts and determine whether each is able to perform the work during the WA period of performance. In addition, the contractor shall identify any actual, potential, or apparent conflicts of interest directly to the Contracting Officer (CO) and WA COR.

The contractor shall submit a final memorandum of proposed peer review candidates to the WA COR with the list of the names and affiliations of the selected peer reviewers, each peer reviewer's curriculum vitae or resume, and a target start date for each person's peer review. The WA COR, through written technical direction, will acknowledge the peer reviewer candidates as proposed for each report/study. The contractor shall not initiate a peer review on a particular report or analysis until such acknowledgement is received.

After reviewing the resume/curriculum vitae of the selected peer reviewer candidates, the WA COR may disagree with the contractor's assessment of a peer review candidate's apparent suitability (potential for COI, appearance of bias, etc) or qualification requirements for any peer review. In such a case, the contractor shall identify an alternate from the pool of peer review candidates and forward details of that candidate to the WA COR. The contractor shall not consult with the WA COR in their selection of the peer reviewers from the list of acceptable candidates.

**Task 2. Peer Review Facilitation**

The WA COR will forward electronically to the contractor each of the four reports/studies and any background materials necessary for each peer review. In addition, the WA COR will provide a list of suggested charge elements/directed questions for reviewers for each of the four reports/studies. The contractor shall begin the actual peer review process by distributing the report or study and all relevant documents, along with a charge letter to the peer reviewers. In the charge to the reviewers, an overall “catch-all” question shall be included at the end of the list of prescribed questions in order to capture other comments by the reviewers that were not outlined in the charge.

The contractor shall manage the peer review process to ensure that each peer reviewer has sufficient time to complete their review of their report/study by deadlines set forth in the deliverables schedule. Any questions that a peer reviewer may have shall be directed back through the contractor for resolution by the WA COR. Any answer with regard to a particular peer review product and the question to which it refers shall, in turn, be shared with the other reviewer of that product. It is not necessary, however, that the peer reviewers jointly reach consensus on their findings and recommendations since there may be limited overlap in the peer reviewers' areas of expertise and the charge question(s) on which a reviewer may choose to focus. The WA COR may provide technical and/or background information as necessary on the report under review.

The contractor shall task the peer reviewers with submitting a written report that includes their response to the charge questions and any additional comments the reviewer may have with regards to the report/study under review. The contractor shall ensure the peer reviewers provide their comments as an enclosure to a cover letter that clearly states the reviewer's name, the name and address of their organization, if applicable, and a statement of any real or perceived conflict(s) of interest. The contractor shall forward these documents to the WA COR in electronic format.

At the conclusion of any peer review, the contractor shall gather all review comments to draft a report of the conduct of that peer review. After a brief period for editorial comment, EPA will return each draft report for the contractor to create final versions of each of the individual peer review reports. The Contractor shall adhere to the provisions of EPA's Peer Review Handbook guidelines to ensure that the on-going peer reviews will conform to EPA peer review policy.

**Task 3: Peer Review Documentation**

The contractor shall prepare a detailed summary of the means by which reviewers were selected, the manner in which the review process was administered, and how the peer review process was brought to a close. The contractor shall include this summary in the documentation of each of the four peer reviews completed under this WA. This information shall be in addition to copies of the reviewers' peer review reports, “raw comments” and other supporting documentation, as detailed in this WA. A summary shall be included as part of each Final Technical Report detailed in Task 4.



#### **Task 4. Draft and Final Technical Report for Each Product Reviewed**

For each of the four reports or analyses peer reviewed, the contractor shall develop a draft technical report with a clear and concise introduction of the peer reviewer process for that particular report or analysis followed by a detailed discussion of the work completed, including any issues encountered. The unedited reviewer comments shall be included with each draft report along with the resumes/CVs and a signed Conflict of Interest statement for each reviewer. EPA will review all four draft reports and submit any comments back to the contractor.

The contractor shall provide the WA COR with a final technical report for all four products reviewed, addressing EPA comments, within two weeks of receiving comments on any draft copy. Each report shall be sent electronically in both Microsoft Word (\*.doc or \*.docx) and Adobe portable document file (\*.pdf) formats.

#### **PROJECT STATUS/REPORTING**

**Bi-Weekly Updates:** The Contractor shall provide status updates through phone teleconferences to the WA COR or their designated alternate on a bi-weekly basis to summarize the progress made to date. The contractor shall indicate progress achieved in the preceding period, technical issues encountered, solutions to issues (proposed or attempted), and project activity for the next two week period. This report shall include any potential issues or circumstances that arise causing delays in the review process. The contractor shall also report if the project is beginning to exceed the hours or dollars agreed upon in the work plan. The contractor shall initiate more frequent contact with the WA COR, as needed, to resolve questions and discuss any technical issues which may arise in the course of the peer review effort.

**Monthly Status Report:** The contractor shall provide a written status report with the monthly invoice. The monthly status reports shall track the progress made on each of the tasks/deliverables for each of the products being reviewed. The report shall summarize hours and dollars expended, as well as projections to complete work, on each of the tasks as detailed in the PWS. The report shall include information such as task and subtask names, hours spent, contact information, task start date and deadlines, deliverables, accomplishments, any technical issues encountered, work on-hold status and whether the project is on schedule. This report shall also include any potential issues or circumstances that may arise causing any delays in the review process.

#### **DELIVERABLES SCHEDULE**

The contractor shall complete deliverables in accordance with the proposed schedule below.

<b>Milestone/Deliverable by Task</b>	<b>Proposed Due Date**</b>
Task 1: Peer Reviewer Selections	
<ul style="list-style-type: none"> <li>Peer reviewer candidates proposed/finalize participation</li> </ul>	<ul style="list-style-type: none"> <li>Four weeks after work assignment issue</li> </ul>

<p>Task 2: Facilitation of Peer Reviews</p> <ul style="list-style-type: none"> <li>• Charge letter/documents to reviewers of Toxics Report and Fleets Report</li> <li>• Peer reviewer's comments due to contractor for Toxics Report and Fleets Report</li> <li>• Charge letter/documents to reviewers of C3 Marine Report and Validation Report</li> <li>• Peer reviewer's comments due to contractor for C3 Marine Report and Validation Report</li> </ul>	<ul style="list-style-type: none"> <li>• Six weeks after work assignment issue</li> <li>• Ten weeks after work assignment issue</li> <li>• Fourteen weeks after work assignment issue</li> <li>• Fourteen weeks after work assignment issue</li> </ul>
<p>Task 3: Documentation of Process</p> <ul style="list-style-type: none"> <li>• Draft Peer Review process summary, CVs, etc. for Toxics Report and Fleets Report</li> <li>• Draft Peer Review process summary, CVs, etc. for C3 Marine Report and Validation Report</li> </ul>	<ul style="list-style-type: none"> <li>• Three months after work assignment issue</li> <li>• Four months after work assignment issue</li> </ul>
<p>Task 4: Draft and Final Technical Reports</p> <ul style="list-style-type: none"> <li>• Final Technical Peer Review reports for Toxics Report and Fleets Report</li> <li>• Final Technical Peer Review reports for C3 Marine Report and Validation Report</li> </ul>	<ul style="list-style-type: none"> <li>• Two weeks after Draft Reports rec'd</li> <li>• Two weeks after Draft Reports rec'd</li> </ul>

\*\* These timelines are subject to negotiation and change as a result of EPA's regulatory schedule, availability of the final review documents and Peer Review Charge or other factors outside of the WA COR's control.

**Appendix A: Partial Lists of Subject Matter Experts**

For each product to be reviewed, the contractor may use the following lists of subject matter experts as a “jumping-off” point from which to assemble the group of candidate peer reviewers. The contractor shall also pursue individuals identified through the contractor’s own means and may query EPA’s WA COR for additional suggested reviewers, as needed.

**Vehicle Population and Activity Update Report:**

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Mobile: 802-356-9161  
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Mohamadreza Farzaneh,  
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Center for Air Quality Studies  
Texas Transportation Institute  
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College Station, Texas 77843-3135)  
Tele: 512-467-0946  
[mfarzaneh@tamu.edu](mailto:mfarzaneh@tamu.edu)

Song Bai, Scientist/Manager  
Transportation Policy & Planning  
Sonoma Technology, Inc.  
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Petaluma, CA 94954-6503  
Tele: 707-665-9900  
FAX: 707-665-9800  
[sbai@sonomatech.co](mailto:sbai@sonomatech.co)

**Speciation Profiles and Toxic Emission Factors for Nonroad Engines:**

Timothy Gordon  
Postdoctoral scholar at NOAA  
NOAA ESRL Chemical Sciences Division  
325 Broadway R/CSD2  
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[Timonthy.Gordon@noaa.gov](mailto:Timonthy.Gordon@noaa.gov)  
(303)497-7972

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**MOVES Validation Report:**

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**Appendix B: Elements to be Addressed in the Charge to the Peer Reviewers**

This Appendix summarizes each product for which EPA has requested an independent peer review. This introduction contains a brief discussion of the contents of each report/analysis and a brief discussion of concerns which would apply to any peer review Agency. The WA COR will forward to the contractor a list of questions which can be included in a charge letter and are specific to each product for review. These questions will direct a peer reviewer to those issues of greatest concern to the Agency.

In their comments, reviewers should distinguish between recommendations for clearly defined improvements that can be readily made based on data or literature reasonably available to EPA and improvements that are more exploratory or dependent on information not readily available to EPA. Any comment should be sufficiently clear and detailed to allow a thorough understanding by EPA or other parties familiar with the analysis or the underlying data. Further, each peer review should address whether appropriate conclusions and implications can be drawn from the report and any subsequent model predictions based on the report contents.

If a reviewer has questions about what is required in order to complete this review or needs additional background material, please direct the reviewer to contact the contractor's project manager for this effort. If a reviewer has a question about the conduct of the EPA peer review process itself, please have the reviewer contact Ms. Ruth Schenk in EPA's Quality Office, National Vehicle and Fuel Emissions Laboratory by phone (734-214-4017) or through e-mail at [schenk.ruth@epa.gov](mailto:schenk.ruth@epa.gov).

EPA requests that the reviewers not release the materials for peer review or the reviewer's comments to anyone else until the Agency makes its report and supporting documentation public.

**Vehicle Population and Activity Update Report:****Report Description**

This report documents changes to assumptions about the US national highway vehicle fleet population and activity data for the next version of the MOVES model. Fleet population and activity data is used to convert emission rates into emission inventory values and then is used to weight individual values into aggregated emission rates. The report also covers the techniques and methods used to map and distribute population and activity data into the categories used by the MOVES model.

Topics addressed by the report include:

- Default source use type data for the national highway vehicle population is being updated with vehicle registration data from Polk for calendar year 2011 and with usage data from the Vehicle Use and Inventory Survey (VIUS) for calendar years 2000, and later;
- Calendar year 2011 as a new base year from which any future population and activity scenarios are grown;

- Vehicle miles traveled (VMT) is being updated from recent Highway Performance Monitoring System (HPMS) data for the 2011 base year, and updating the projections for future years;
- National default speed distributions by road type are being updated based on recent data obtained from a passenger car GPS provider;
- Monthly motorcycle VMT distribution is being updated to better reflect the seasonal nature of motorcycle use;
- New driving cycles are included for medium and heavy-duty vehicles at low and high speed;
- New Source Classification Codes (SCC) are developed which are more consistent with MOVES classifications of motor vehicles and fuels;
- New default geographic distribution of VMT, population, age and road types are included from the 2011 National Emission Inventory; and
- New road type (*Ramps*) is included in MOVES.

Estimated effort: approximately 15 hours / 60 pages

### **Speciation Profiles and Toxic Emission Factors for Nonroad Engines:**

#### **Report Description**

This report documents the inclusion of development of NONROAD toxic emission rates that are proposed to be incorporated into MOVES2014a. The report also documents parameters used to derive methane, non-methane hydrocarbon emissions (NMHC), non-methane organic gases (NMOG), volatile organic compound (VOC), and total organic gas (TOG) emission rates from NONROAD total hydrocarbon (THC) emission rates. In addition, this report documents the development of speciation profiles that will be applied to TOG and PM<sub>2.5</sub> by SMOKE to compute air quality model ready species.

Estimated effort: approximately 10 hours / 35 pages

### **MOVES Validation Report:**

#### **Report Description**

This report is a validation of the MOVES2014 emission rate values. The report compares emission rates used in MOVES to emission test programs that were not used to derive MOVES emission rates. It also discusses comparisons of MOVES to emission rates derived from tunnel, roadside, and air quality monitoring data.

Estimated effort: approximately 15 hours / 60 pages



**C3 Commercial Marine Bunker Fuel Demand Update:****Report Description**

This report presents updated specific fuel consumption (SFC) and bunker fuel demand by eight commodity types and five US regions for all years from 1995 to 2030. It is an update of the analysis that was done in 2006 for EPA's C3 Rule. Ship analysis by vessel and size category is combined with trade analysis by commodity and trade route in a GAMS model that estimates bunker fuel demand. This report differs from the previous one in being based on more recent data and taking into account efficiency improvements resulting from regulation, from improvements in ship technology, and from changes in operating practices.

Estimated effort: approximately 15 hours / 60 pages

<b>EPA</b> United States Environmental Protection Agency Washington, DC 20460 <b>Work Assignment</b>						Work Assignment Number 3-08				
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:				
Contract Number EP-C-12-011			Contract Period   02/01/2012   To   09/30/2015 Base                      Option Period Number       3			Title of Work Assignment/SF Site Name Travel Efficiency Assessment				
Contractor ICF INCORPORATED, L.L.C.					Specify Section and paragraph of Contract SOW Task 7a					
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval						Period of Performance  From   01/27/2015   To   09/30/2015				
Comments:										
<div style="display: flex; justify-content: space-between;"> <input type="checkbox"/> Superfund         <span>Accounting and Appropriations Data</span> <input checked="" type="checkbox"/> Non-Superfund       </div>										
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.										
SFO (Max 2) <input type="checkbox"/>										
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										
Authorized Work Assignment Ceiling										
Contract Period:		Cost/Fee:			LOE:					
02/01/2012   To   09/30/2015										
This Action:										
Total:										
Work Plan / Cost Estimate Approvals										
Contractor WP Dated:				Cost/Fee:			LOE:			
Cumulative Approved:				Cost/Fee:			LOE:			
Work Assignment Manager Name    Patty Klavon  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number   734-214-4476 FAX Number:			
Project Officer Name    Greg Janssen  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number: 734-214-4285 FAX Number: 734-214-4821			
Other Agency Official Name    Jose Ortiz  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number: 513-487-2831 FAX Number: 513-487-2109			
Contracting Official Name    Sandra Savage  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number: 513-487-2046 FAX Number:			

## PERFORMANCE WORK STATEMENT

**Work Assignment (WA):** 3-08

**Title:** Travel Efficiency Assessment Methodology Case Studies

**Contractor:** ICF International  
9300 Lee Highway  
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**Period of Performance:** Initiation to September 30, 2015

### **BACKGROUND**

The Transportation and Climate Division (TCD) of the EPA's Office of Transportation and Air Quality (OTAQ) provides analysis, guidance and technical assistance of transportation policy and program effects on mobile source emissions and air quality to Federal, State, and local agencies and governments. These stakeholders are increasingly interested in evaluating the effectiveness of travel efficiency (TE) and other related strategies for reducing emissions of criteria pollutants and their precursors as well as greenhouse gases (GHG).

In March 2011, TCD published a report titled *Potential Changes in Emissions Due to Improvements in Travel Efficiency*. This report outlines a peer reviewed methodology, the "Travel Efficiency Assessment Method," (or "TEAM") for evaluating the emission benefits of travel efficiency strategies.<sup>1</sup> This report and the accompanying "User Guide" served as a guide for conducting three case studies under work assignment 1-08 (EP-C-12-011). Under that work

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<sup>1</sup> TEAM is a methodology developed by EPA, which combines the use of a transportation sketch planning tool that estimates changes in travel activity with estimates of emission rates from MOVES, to produce emissions estimates from travel activity. Changes in travel activity, estimated for representative urban areas of the country, are applied to similar urban areas and then scaled up to estimate changes travel activity for the entire nation. Emissions estimated by MOVES are combined with the estimated change in travel activity to estimate changes in emissions.

assignment, the potential benefit of TE strategies was modeled in three different regions, chosen from 10 that submitted letters of interest. In January 2014, TCD published a report of the findings, *Estimating Emission Reductions from Travel Efficiency Strategies: Three Sketch Modeling Case Studies*. This report documents the application of TEAM in Boston, Kansas City, and Tucson to assess the potential regional emission reductions from travel efficiency strategies.

The case studies offered an opportunity for the EPA to assess travel efficiency strategies, to demonstrate the capabilities of the TEAM approach, and to evaluate its usefulness at the regional scale. The resulting report documents the process, modeling and analyses performed in partnership with regional planners from the three cities chosen.

### **PURPOSE**

This work assignment is similar to WA 1-08 (Contract #: EP-C-12-011) in that the objective is for the contractor to provide technical assistance for GHG planning and TE assessment case studies based upon TEAM for three more areas that submitted letters of interest.

Under WA 0-08 of this contract, EP-C-12-011, the contractor identified and evaluated state and local areas as potential candidates for technical assistance. Under this work assignment, the Contractor shall secure an agreement from three (3) such agencies to participate in the TE assessment case studies, develop a plan to coordinate the stakeholder process, perform the analyses, document the experience and technical results in draft and final memoranda, and create a final report.

These case studies shall integrate the use of the Trip Reduction Impacts of Mobility Management Strategies (TRIMMS) transportation/land-use sketch model and the EPA's Motor Vehicle Emissions Simulator (MOVES) emissions model to demonstrate: (1) how TEAM can be adapted and used cost-effectively to create state, regional or local inventories of on-road GHG and criteria emissions, and (2) the feasibility of scenario analysis as a useful source of information on the effectiveness of travel efficiency strategies for reducing travel activity and emissions. While sketch tools are not a substitute for traditional comprehensive transportation, land-use, and air quality modeling, they can serve an important role by allowing local officials to analyze a range of travel efficiency strategies (such as pricing, land-use, and transit), which cannot easily be modeled with traditional approaches such as regional travel demand forecasting models.

This work assignment also includes two optional tasks (Task 6-7). If Task 6 is implemented, the Contractor shall update the modeling of the scenarios chosen by the three areas evaluated in the 2013 case studies: Pima Association of Governments, Massachusetts DOT, and Mid-America Regional Council. As this is an optional task, the Contractor shall provide a cost estimate for this task separate from the Contractor's cost estimate for Tasks 1-5 of this work assignment.

If Task 7 is implemented, the contractor shall perform a literature review on the topic of the cost and/or cost effectiveness of implementing the types of TE measures that are examined in the case studies, as well as several additional strategies. The EPA has developed significant information on the emission reduction potential of many of these types of measures. The EPA seeks to expand this work by examining the costs and/or cost effectiveness of these types of measures.

As this is an optional task, the Contractor shall provide a cost estimate for this task separate from the Contractor's cost estimate for Tasks 1-5.

## **TASKS**

### **Task 1: Stakeholder Identification and Process Development**

The EPA will provide the Contractor with a list of three state and local area agencies (the "selected agencies") who have been selected to receive technical assistance under this work assignment.

In consultation with the EPA, the Contractor shall work with each of the selected agencies to identify the specific representatives of the selected agency as well as other stakeholders in that area who should be involved in carrying out the case study. The agency representatives and other area stakeholders shall be consulted on the selection of the travel efficiency strategy scenarios that shall be modeled and on the selection of data necessary to model these scenarios in accordance with this work assignment. Stakeholder participants shall include a representative from the agency that submitted the letter of interest and, to the extent possible any partner agency identified in that letter. The Contractor shall work with such representatives to determine if representatives from other state or local agencies, such as air quality, energy, transportation and transit agencies, as well as land-use agencies, should also be included as stakeholders in the planning and conducting of the case study.

In collaboration with the EPA, the selected agencies, and any other stakeholders identified above, the Contractor shall develop and conduct a coordinated process to determine consensus on the key inputs and assumptions for each selected agency's case study. The case study for each selected agency shall consist of one (1) or more TE strategy scenarios that shall be modeled and analyzed for some future year (see Task 2 for complete details about these scenarios). The analysis year for each scenario in any area shall be the same so that the results can be compared to one another, but the analysis years can differ among the selected agencies, depending on the year chosen by the participating stakeholders in each area.

The Contractor's plan for conducting this process shall describe, at a minimum, how the necessary data for completing each analysis shall be identified, collected, and prepared for each selected agency's case study. Analytical metrics, including but not limited to, baselines, analysis years, and appropriate data (such as vehicle miles traveled, trip volumes, mode shares, travel costs, population and densities) to represent strategy scenario implementation shall be identified. The process shall allow sufficient time for interagency review and agreement on the case study scenarios and model inputs. All meetings shall be conducted via conference call or web meeting.

### **Deliverables**

1. Draft memo describing the plan for the stakeholder process for reviewing strategies, modeling inputs, and analysis of results for each selected agency
2. Final memo describing the plan for the stakeholder process for reviewing strategies, modeling inputs, and analysis of results for each selected agency
3. Draft list of stakeholders and potential case study scenarios for each selected agency
4. Final list of stakeholders and potential case study scenarios for each selected agency

## **Task 2: Review of Land Use Elasticities**

The Contractor shall prepare a brief memo that compares the land use planning inputs and elasticities used in TRIMMS, and land use inputs and elasticities used in other models or highlighted in other research. Land use planning inputs and/or elasticities could include residential density, retail establishment density, land use mix, transit accessibility, and presence of transit oriented development, as well as other measures. The Contractor shall find and compare these inputs and elasticities from the following sources, at a minimum:

- Those used in the version of TRIMMS used for the first three case studies done under work assignment 1-08 (EP-C-12-011);
- Those used in the latest version of TRIMMS, if different from the above;
- Those used in the National TEAM study (March 2011, “Potential Changes in Emissions Due To Improvements in Travel Efficiency”); and
- Those from recent research, including the 2012 Transportation Research Part D journal article by Salon et al, (the WA COR will forward to the contractor).

The memo shall include a table comparing these inputs and elasticities, and the Contractor’s evaluation of these, including pros and cons. The memo shall document the supporting information and factors that were used to develop the inputs and elasticities for the above sources. The memo shall also include the Contractor’s recommendation and a rationale for how to best account for land use changes in the case studies done under this work assignment. The EPA will review and comment on the draft memorandum. The Contractor shall incorporate EPA comments in a final memo within 14 days of receiving comments from the EPA.

### **Deliverables**

5. Draft memo comparing land use elasticities and making a recommendation
6. Final memo comparing land use elasticities and making a recommendation

## **Task 3: Evaluation of Transportation Strategies Using The Team Method**

The EPA will provide the Contractor with three (3) selected agencies with whom to work to complete the case studies. For each of the three selected agencies, the Contractor shall complete subtasks a, b, and c:

### **Subtask a.**

The Contractor shall coordinate with the EPA, the selected agency, and stakeholders to establish the modeling baseline and agree on up to six (6) transportation strategy scenarios to be analyzed as part of each case study.<sup>2</sup> One scenario shall be “business as usual” to reflect a future year base case against which the other scenarios can be compared. This “business as usual” scenario shall reflect the land use changes and growth in transportation that the MPO is currently anticipating for the chosen analysis year. The other scenarios could potentially include any transportation control measure or other VMT-reducing strategy, or grouping of strategies, that are not already

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<sup>2</sup> A maximum of 18 transportation strategy scenarios (six for each of the three selected agencies) could potentially be analyzed under this subtask.

included in the “business as usual” scenario that TRIMMS is capable of analyzing. Such strategies could include:

- Travel demand management measures
- Land use strategies
- Transit fare discounts and service improvements
- Road pricing measures (including parking charges and mileage-based fees)
- Any combination of the above strategies.

The Contractor shall coordinate with EPA, the selected agency, and any stakeholders, on how to best specify each scenario to be analyzed, including the appropriate model input and output values. The Contractor shall work with the selected agency and stakeholders to identify travel data and any other data necessary to run the TRIMMS and MOVES models for the chosen scenarios. The Contractor shall provide a draft copy of all proposed model inputs to the WA COR, the selected agency, and stakeholders. These inputs will be reviewed by the EPA, the selected agency, and stakeholders and revised per their review. Modeling and analysis shall not begin until the EPA has determined that sufficient agreement has been reached among the EPA, the selected agency, and any stakeholders on the scenarios to be modeled and the modeling specifications. The Contractor shall receive written technical direction from the WA COR approving the final inputs prior to the Contractor starting any modeling.

#### Subtask b.

The Contractor shall model and analyze each strategy scenario using, to the extent practical, the TEAM methodology described and used in the June 2014 report: EPA-420-R-14-003a, “Estimating Emission Reductions from Travel Efficiency Strategies: Three Sketch Modeling Case Studies” which can be found at this URL:

<http://www.epa.gov/otaq/stateresources/policy/420r14003a.pdf> (note that the geographic scope for modeling and analysis shall not be performed at the national scale, as was done in that work assignment). The Contractor shall use TRIMMS to perform the transportation sketch modeling for TE strategies other than land use. For land use, the Contractor shall use a method as provided in written technical direction by the WA COR based on the memo written under Task 2. The MOVES emissions model shall be run at the county scale using inputs based on local data specific to each participating area, to the extent practicable, and adhere to the latest EPA guidance for estimating on-road greenhouse gas emissions.<sup>3</sup> The Contractor shall report any recommended deviations from the aforementioned methodology and guidance to the EPA as soon as they are identified; any such deviations shall only be followed upon receipt of written technical direction from the WA COR.

#### Subtask c.

Following completion of the TRIMMS and MOVES modeling for each selected agency, the Contractor shall submit draft technical results to the WA COR using the same tabular format used to publish the results in the report: *Potential Changes in Emissions Due to Improvements in Travel Efficiency*. These results shall include estimates for Volatile Organic Compounds (VOC), Nitrogen Oxides (NOx), Fine Particulate Matter (PM2.5), and Carbon Dioxide (CO2).

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<sup>3</sup> On the date of this Performance Work Statement, the latest available guidance, *Using MOVES for Estimating State and Local Inventories of On-Road Greenhouse Gas Emissions and Energy Consumption – Final, November 2012*, could be found at <http://www.epa.gov/otaq/stateresources/ghgtravel.htm>.

Within 14 days of review and approval of the technical results described above, the Contractor shall submit draft memoranda (one for each selected agency) describing and documenting the modeling assumptions, strategies assessed, and results. In addition to the draft memoranda, the Contractor shall submit the MOVES RunSpec file for each scenario analyzed and the MOVES input and output databases associated with each MOVES run. The Contractor shall name these three items similarly so that it is clear which files and databases are associated with one another.<sup>4</sup>

The EPA, selected agencies, and any stakeholders will review and comment on the draft memoranda and MOVES files/databases. The Contractor shall incorporate any agency and EPA comments in a final memo within 14 days of receiving comments.

#### **Deliverables**

7. Proposed TRIMMS and MOVES inputs for each case study scenario
8. Final TRIMMS and MOVES inputs for each case study scenario
9. MOVES RunSpec file, input database, and output database for each case study scenario
10. Results in tabular format for each case study scenario
11. Draft results memoranda with assumptions, strategies and results for each selected agency
12. Final results memoranda with assumptions, strategies and results for each selected agency

#### **Task 4: Review of Existing Greenhouse Gas Analyses**

As part of the case study of each selected agency, the Contractor shall prepare a brief memo reviewing and describing any regional-scale greenhouse gas analyses the selected agency (or any associated stakeholder) may have recently completed in the area. The Contractor shall document any differences between the methodology used in any such analyses and the method described by TEAM. This task need not necessarily include a comparison of specific quantitative results between any existing greenhouse gas analyses and the TEAM results produced in Task 2 in cases where the methodologies are not comparable, but at a minimum, shall include a qualitative evaluation of the results and a discussion about how the different methodologies and source data and assumptions could influence the results. The Contractor shall include the results of this task in the appropriate case study report (see Task 5).

#### **Deliverables**

13. Draft memo identifying other regional-scale greenhouse gas analyses and comparing methodologies for each selected agency
14. Final memo identifying other regional-scale greenhouse gas analyses and comparing methodologies for each selected agency

#### **Task 5: Case Study Reports**

The Contractor shall incorporate the results of Tasks 1-4 into a draft report. The memoranda for the previous tasks shall form the basis of the draft report, which shall include, at a minimum:

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<sup>4</sup> For example, the MOVES RunSpec name could be “areaname\_scenario1.mrs,” the input database “areaname\_scenario1\_in,” and the output database “areaname\_scenario1\_out.”



- An overall summary and general conclusions, considering the results of all three case studies;
- Self-contained sections containing the results of each selected agency's case study, including the stakeholder process involved, the strategies evaluated in each case study, the assumptions and methodologies used in the strategy evaluations, evaluation of the adherence or deviation from TRIMMS and MOVES guidance, and any challenges (technical or otherwise) encountered and how they were addressed; and
- Information, including any lessons learned or best practice, determined to be useful to other state or local areas wishing to perform its own analysis of GHG or criteria emissions reductions for various travel efficiency scenarios.

The EPA will review the initial version of the draft report. After incorporating any EPA comments received from the WA COR, the Contactor shall send the draft report to the selected agencies (and associated stakeholders, as needed) for their review and comment. After receiving comments from the selected agencies and any stakeholders, the Contractor shall arrange for and facilitate any discussions between the EPA, selected agencies, and any stakeholders, via conference call or web- based meeting, to develop consensus on the final text.

After receiving final comments on the draft report from the EPA, selected agencies, and any stakeholders, the Contractor shall develop a final report for this task. The final report shall respond to any comments received on the draft. The Contractor shall submit a draft of this final report to the WA COR for review and comment. Within 14 days of receiving comments, the Contractor shall submit a final copy incorporating the comments received.

#### **Deliverables**

15. Draft final report
16. Final report

#### **Optional Task 6: Update 2013 Case Studies**

Upon receipt of written technical direction from the WA COR, and CO approval if necessary, the Contractor shall update the modeling of the scenarios chosen by the three areas for the 2013 case studies: Pima Association of Governments, Massachusetts DOT, and Mid-America Regional Council. The Contractor shall update the land use component of the TRIMMS analysis according to that used in Task 3, subtask b, and update the emissions modeling with MOVES2014. The Contractor shall present these results in a draft memo to the WA COR for review and comment. The Contractor shall revise the memo and submit a final copy within 14 days of receipt of comments.

#### **Deliverables**

17. Draft memo describing the update to the 2013 case studies and the results
18. Final memo describing the update to the 2013 case studies and the results

#### **Optional Task 7: Review of Literature Cost and Cost Effectiveness of Implementing Travel Efficiency Strategies**

Upon receipt of written technical direction from the WA COR, and CO approval if necessary, the Contractor shall conduct a thorough review of the literature concerning the cost and/or cost effectiveness of implementing TE strategies including:

- Travel demand management measures
- Land use strategies
- Transit fare discounts and service improvements
- Road pricing measures (including parking charges and mileage-based fees)
- Alternate fuel vehicles
- Emerging strategies, such as eco-driving, pay-as-you-go insurance, operational efficiencies from using smart phone technology, and increases in vehicle renting rather than ownership.

The review shall focus on information published in the last 10 years. Sources may include, but are not limited to: TRB reports; papers in transportation-related journals; and studies prepared by or for universities, state departments of transportation, metropolitan planning organizations, and other similar state or local agencies. For the purpose of this task, cost effectiveness is broadly defined. The contractor shall include literature that addresses cost effectiveness on a dollar per ton reduced basis for one or more pollutants (e.g., PM2.5, NO<sub>x</sub>, VOCs and CO<sub>2</sub>) as well as literature that addresses broader costs and benefits to society such as literature on the cost of sprawl. The Contractor shall provide the EPA with a draft memo that summarizes the findings of the review. This shall include for each item found through the review:

- A summary of the information on cost or cost effectiveness.
- A brief description of the methodology and data sources used by the authors and major assumptions that were made.
- A complete reference to the study or journal article.

The EPA will review and comment on the draft memorandum. The Contractor shall incorporate EPA comments in a final memo within 14 days of receiving comments.

### **Deliverables:**

19. Draft memo on the results of the literature review as described above
20. Final memo on the results of the literature review as described above

### **CONSOLIDATED DELIVERABLES AND SCHEDULE**

Note: Due dates are notional and subject to change based on Contractor's work plan and subsequent discussions and written agreement between WA COR and the Contractor.

<b><u>Task No.</u></b>	<b><u>Deliverable(s)</u></b>	<b><u>Schedule/Due Date</u></b>
Task 0	Quality Assurance Project Plan	10 days after work plan approval
Task 1		
1	Draft memo describing the planned stakeholder engagement and scenario development process	30 days from initiation
2	Final memo describing the planned stakeholder engagement and scenario development process	45 days from initiation

3	Draft list of stakeholders and potential case study scenarios	60 days from initiation
4	Final list of stakeholders and potential case study scenarios	75 days from initiation
Task 2		
5	Draft memo comparing land use elasticities	
6	Final memo comparing land use elasticities.	
Task 3		
7	Proposed TRIMMS and MOVES modeling inputs	90 days from initiation
8	Final TRIMMS and MOVES modeling inputs	105 days from initiation
9	MOVES RunSpecs and databases for each case study scenario	120 days from initiation
10	Tabular results for each case study scenario	120 days from initiation
11	Draft modeling results memoranda for each selected agency	135 days from initiation
12	Final modeling results memoranda for each selected agency	165 days from initiation
Task 4		
13	Draft GHG comparison memo	135 days from initiation
14	Final GHG comparison memo	165 days from initiation
Task 5		
15	Draft final report	180 days from initiation
16	Final report	240 days from initiation
Optional Task 6:		
17	Draft memo updating 2013 case studies	180 days from initiation
18	Final memo updating 2013 case studies	240 days from initiation
Optional Task 7:		
19	Draft literature review memo	180 days from initiation
20	Final literature review memo	240 days from initiation

## **DISTRIBUTION AND FORMAT OF DELIVERABLES**

The Contractor shall deliver all work assignment deliverables, including status reports and interim products, in an appropriate electronic format (e.g., Microsoft Word, Excel, and Acrobat). MOVES input and output databases can be submitted as MySQL databases. This applies to all tasks under this work assignment unless otherwise specified in written technical direction by the EPA WA COR.

<b>EPA</b> United States Environmental Protection Agency Washington, DC 20460 <b>Work Assignment</b>						Work Assignment Number 3-09			
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:			
Contract Number EP-C-12-011			Contract Period   02/01/2012   To   09/30/2016 Base                      Option Period Number       3			Title of Work Assignment/SF Site Name Cost Reduction - Learning			
Contractor ICF INCORPORATED, L.L.C.				Specify Section and paragraph of Contract SOW Tasks 2b and 2i					
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval						Period of Performance  From   01/12/2015   To   09/30/2015			
Comments:									
<input type="checkbox"/> Superfund    Accounting and Appropriations Data <input checked="" type="checkbox"/> Non-Superfund									
SFO (Max 2) <input type="checkbox"/> Note: To report additional accounting and appropriations data use EPA Form 1900-69A.									
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars) (Cents)	Site/Project (Max 8)	Cost Org/Code
1									
2									
3									
4									
5									
Authorized Work Assignment Ceiling									
Contract Period:		Cost/Fee:				LOE:			
02/01/2012   To   09/30/2016									
This Action:									
Total:									
Work Plan / Cost Estimate Approvals									
Contractor WP Dated:				Cost/Fee		LOE:			
Cumulative Approved:				Cost/Fee		LOE:			
Work Assignment Manager Name   Christopher Lieske						Branch/Mail Code:			
_____ (Signature)    (Date)						Phone Number: 734-214-4584			
						FAX Number:			
Project Officer Name   Greg Janssen						Branch/Mail Code:			
_____ (Signature)    (Date)						Phone Number: 734-214-4285			
						FAX Number: 734-214-4821			
Other Agency Official Name   Jose Ortiz						Branch/Mail Code:			
_____ (Signature)    (Date)						Phone Number: 202-564-6762			
						FAX Number:			
Contracting Official Name   Sandra Savage						Branch/Mail Code:			
_____ (Signature)    (Date)						Phone Number: 513-487-2046			
						FAX Number:			

## **PERFORMANCE WORK STATEMENT**

EPA Contract: EP-C-12-011

Work Assignment (WA): 3-09

Issuing Office: US Environmental Protection Agency  
Office of Transportation and Air Quality (OTAQ)  
2000 Traverwood Dr.  
Ann Arbor, Michigan 48105

Contractor: ICF International  
9300 Lee Highway  
Fairfax, VA 22031-1207

Statement of Work: Cost Reduction through Learning in Manufacturing  
Industries and in the Manufacture of Mobile Sources

Period of Performance: Initiation – September 30, 2015

Work Assignment Contracting Officer Representative (WA COR):  
Christopher Lieske  
734-214-4584  
lieske.christopher@epa.gov

Alternate WA COR: Gloria Helfand  
734-214-4688  
helfand.gloria@epa.gov

### **BACKGROUND**

Since the late 1990s, EPA's Office of Transportation and Air Quality (OTAQ) has included a learning effect when estimating the costs of regulatory packages. Specifically, technology costs—for technologies added to mobile sources to allow for compliance with new emissions standards—are estimated to decrease in the years following first implementation. This decrease in technology costs, either due to the volume of production or to time, is considered to be due to learning. Learning may reflect efficiencies gained in production processes, in the design of the manufactured components, or some combination of each. These may result from phenomena such as learning by doing, technological innovation, or other mechanisms.

This learning effect has been studied by academia and industry for more than 60 years. Many studies are available that examine the learning effect, or aspects of it; the vast majority of these studies conclude that cost reductions through learning do, in fact, occur. Other studies assume that cost reductions will occur based on the body of evidence suggesting that they do and incorporate learning effects into their analysis, as EPA does in its cost analyses.

While there is little doubt that this learning effect occurs, the learning estimates used by OTAQ in its cost analyses are based on somewhat dated studies that are not specific to the mobile source sector(s). Therefore, the goal of this work assignment is to develop a single compendium study on industrial learning in the mobile source sector(s) that can be relied on as the basis for this effect in future cost analyses.

## **SCOPE**

The purpose of this work assignment is to provide an assessment of learning, as it relates to the mobile source sector, which meets the highest academic and professional standards of credibility. This work assignment is a continuation of Work Assignment (WA) 2-09, Amendment 1 under EPA contract EP-C-12-011. The Contractor shall not duplicate any work performed under the earlier work assignment. The Contractor substantially completed Tasks 1 and 2, with the exception of responding to EPA comments on the Task 2d interim report, where this work assignment resumes.

The assessment of learning covers most notably the automotive industry (both original equipment manufacturers and Tier 1 suppliers). In addition to studies of learning for the light-duty vehicle sector and automotive parts suppliers, the scope of learning assessment covers other on-road mobile source sectors, such as manufacturing of loose engines (those built for installation in large highway trucks and/or nonroad equipment), manufacturing of large vocational/line-haul trucks and manufacturing of large nonroad equipment. This work shall provide a definitive, reliable, single source of information demonstrating the occurrence of learning in the mobile source industries. It shall also summarize empirical estimates of the learning effect separately for each of the specific mobile source sectors (e.g., original equipment auto makers, parts suppliers to those auto makers, loose engine manufacturers, large truck manufacturers, and nonroad equipment manufacturers) for which studies are found that address those specific sectors.

## **TASKS**

### **Task 1 – Identify an Appropriate Advisor to Assist in Literature Searches and Determining the Quality of Studies Found**

Task 1 of WA 2-09 directed the Contractor to assign a Subject Matter Expert (SME) to act as a subject matter advisor for the work assignment. The Contractor assigned an SME which concluded Task 1 of the work assignment. This new WA 3-09 assumes that the SME assigned in WA 2-09 shall continue to act as SME under this new WA until the completion of the work. If the Contractor anticipates changing the SME for this WA, the contractor shall notify EPA in the Workplan, identifying the new SME selected by the Contractor, his/her affiliations, and copies of his/her resume. Given the critical nature of the SME's role, over the course of the WA, the Contractor shall notify EPA of any significant change in the availability of the SME to complete the tasks described below.

### **Task 2 – Conduct a Literature Review of Studies Conducted Concerning the Learning Effect in Mobile Source Manufacturing Industries**

Under WA 2-09, Task 2 subtasks 2a through 2c generally consisted of assembling and reviewing published studies and literature on the learning effect in manufacturing in general and the mobile source sector specifically. The literature search associated with Task 2 is concluded. The

contractor shall not conduct additional research for Task 2 under WA 3-09. However, if the Contractor or EPA identifies other studies or literature that contribute to the overall quality of the analysis, they may be added to the work assignment by written technical direction from the WA COR.

#### Task 2d – Interim Report

Under Task 2 of work assignment 2-09, the Contractor delivered to EPA the 1<sup>st</sup> interim report specified in WA 2-09, Amendment 1 Subtask 2d. EPA will review and provide comments on this interim report. The Contractor shall incorporate EPA comments on the Interim Report in the Draft Final Report discussed in Task 5. The Contractor is not required to provide a revised version of the Interim Report prior to the Draft Final Report.

#### **Task 3 – Summarize Research Conducted, Results and Conclusions of those Studies Deemed to be the Most Relevant**

Task 3 consists of summarizing the studies assembled on the lists described in Task 2, as described below. The SME shall provide significant support in identifying relevant articles and in summarizing and synthesizing the knowledge contained in those articles. For the purpose of this task, the aspects of learning being examined shall include but not be limited to: learning-by-doing, technological change, increasing productivity, and such other effects identified in the studies. The summaries shall specify for each study whether the analysis contained in the study focuses on changes in costs as cumulative output increases, changes in costs over time, or other metrics identified in the studies.

#### Subtask 3a – Summary of Task 2a and 2c Studies

The SME, with the assistance of the Contractor, shall summarize each of the studies assembled on the lists described in Subtasks 2a and 2c of WA 2-09. The individual summaries shall include detailed descriptions of at least the following information:

- Citation (authors, date, publication data)
- Specific industry/mobile source sector examined
- Research question
- Type of learning effect examined
- Description, including year(s), of data set used
- Description of methodology used
  - Quantitative or qualitative
  - If quantitative, model type and statistical methods
- Conclusions, including any quantitative estimates of learning effects
- SME/Contractor's assessment of the study
  - Are the conclusions supported by the data analysis, historical material, case studies, statistics, etc
  - Strengths/weaknesses
- Such other information as the SME/Contractor deem necessary to perform the analysis described in Subtask 4

In addition to the individual study summaries, the SME, with the assistance of the Contractor, shall provide a memo that briefly describes: the extent to which the body of literature contained



in the studies identified in Task 2a and 2c of WA 2-09 shows a general agreement about the existence of learning in general and in the mobile source sector specifically; the different forms of learning that have been studied (including but not limited to: learning-by-doing, technological change, increasing productivity, and other effects identified in the studies); the range of values for empirical estimates of learning in general and the different forms of learning; and the robustness of these findings.

#### Subtask 3b – Summary of Task 2b Studies

The SME, with the assistance of the Contractor, shall summarize each of the studies assembled on the list described in Subtask 2b of WA 2-09. The individual summaries shall include detailed descriptions of at least the following information:

- Citation (authors, date, publication data)
- Specific industry/mobile source sector examined
- Type of learning effect examined; research question
- Whether methodology is quantitative or qualitative
- Conclusions, including any quantitative estimates of learning effects

#### Subtask 3c – 2<sup>nd</sup> Interim Report

Within 5 weeks of work plan approval, the Contractor shall submit a report containing the summaries described in Subtasks 3a and 3b to the EPA WA COR. The summaries may be provided in tabular form or by a separate electronic data sheet for each study, but shall allow for easy comparison across studies. This report shall also include the memo described in Subtask 3a. EPA will review and provide comments within 2 weeks of receipt of this interim report.

### **Task 4 – Synthesis of Learning Literature**

Task 4 consists of drawing together the information assembled in Tasks 2 and 3 to describe the impacts of learning in general manufacturing and the mobile source sector specifically, and to estimate the magnitude of those effects. The SME shall provide significant support in this aspect of the analysis.

#### Subtask 4a - Synthesize Research Conducted, Results and Conclusions of the Studies.

The SME, with the assistance of the Contractor, shall synthesize the body of literature gathered in Tasks 2 and 3. For general manufacturing and for each mobile source sector for which there is information, this analysis shall indicate the occurrence of learning in the relevant sector, describe the types of learning observed and the magnitude of each, and report the magnitude of the estimated combined effects of different types of learning on production costs. Where possible for the mobile source sector, the discussion shall identify estimates of learning separately for the original equipment automotive industry, the automotive parts supply industry, loose engine manufacturers, large truck manufacturers, and nonroad equipment manufacturers, to the extent that estimates exist in the literature reviewed. The synthesis shall also compare estimates of learning in mobile source sectors to estimates of learning in general manufacturing.

#### Subtask 4b – Methodology to Estimate Learning in the Mobile Source Sector

The SME, with the assistance of the Contractor, shall develop a methodology to estimate the impacts of learning using the quantitative estimates and other data from the Task 2c studies. The Contractor shall receive approval of the methodology in written technical direction from the EPA

WA COR. The development of the estimates in Subtask 4c utilizing this methodology shall not proceed before such written technical direction is received.

#### Subtask 4c – Estimating Learning in the Mobile Source Sector

Using the methodology approved in subtask 4b, the SME, with the assistance of the Contractor, shall develop a best estimate for learning for each of the separate mobile source industries for which published data exists. For those sectors for which published data does not exist, the SME, with the assistance of the Contractor, shall recommend whether and how the information gathered in Tasks 2 and 3 can be used to describe the impact of learning in those sectors.

#### Subtask 4d – 3rd Interim Report

Within 4 weeks of EPA's approval of the 2<sup>nd</sup> Interim Report described in Subtask 3c, the Contractor shall submit to the EPA WA COR a report containing the assessment described in Subtask 4a, the methodology described in Subtask 4b, and learning effects estimated in Subtask 4c. This report shall also include a brief assessment by the subject matter expert with regard to his or her evaluation of the robustness of the estimated learning impacts for each of the relevant mobile source sectors, and implications of those estimates for those mobile source sectors for which estimates were not possible. EPA will review and provide comments on this interim report within 2 weeks of receipt of this interim report.

#### **Task 5: Draft Final Report**

Within 4 weeks of EPA's written approval of the Interim Report described in Task 4d, the Contractor shall submit a draft final report containing the work called for in Tasks 2 through 4 to the EPA WA COR. EPA will review and provide comments on this interim report within 4 weeks of receipt of this interim report.

#### **Task 6 – Final Report**

After EPA provides the Contractor with comments on the draft final report, the Contractor shall then prepare a final report based on the draft final report described above in Task 5 taking into account the comments provided by EPA. The Contractor shall submit the final report within 4 weeks of receipt of the comments provided by the EPA WA COR on the draft final report.

#### **Weekly Meetings**

The contractor shall hold weekly meetings with the WA COR or Alternate WA COR by telephone conference. In these meetings, the contractor shall report progress, new or unforeseen circumstances, and raise issues regarding the performance of the work assignment. The WA COR or Alternate WA COR shall respond to questions, provide information and raise or clarify technical issues.

#### **DELIVERABLES**

The Contractor shall deliver the following work products to the EPA WA COR during the course of this work assignment:

- Quality Assurance Project Plan (QAPP).
- 1<sup>st</sup> Interim Report, Task 2d - The Contractor delivered an interim report to EPA under WA 2-09 as described in Task 2d, including the list of articles described in that task. The

Contractor shall review EPA comments with EPA and incorporate those comments in the Task 5 Draft Final Report.

- 2<sup>nd</sup> Interim Report, Task 3 - The Contractor shall deliver an interim report to the EPA WA COR as described in Task 3 of the work assignment, including the summaries of the articles described in that task. The Contractor shall deliver the draft report in Microsoft Word format.
- 3<sup>rd</sup> Interim Final Report, Task 4 - The Contractor shall deliver an interim report to the EPA WA COR as described in Task 4 of the work assignment. The Contractor shall deliver the draft report in Microsoft Word format.
- Draft Final Report, Task 5 - The Contractor shall deliver a draft final report to the EPA WA COR combining the results of Tasks 2 through 4 of the work assignment. This draft final report shall incorporate EPA's comments on the interim reports. The Contractor shall deliver the draft final report in Microsoft Word format.
- Final Report, Task 6 – After responding to or incorporating the comments provided by EPA on the draft final report, the Contractor shall prepare and submit a final report. The Contractor shall deliver the final report in Microsoft Word format.

#### Schedule of Deliverables

<b>Item</b>	<b>Duration</b>	<b>Deliverable due upon completion of task</b>
<i>WA 2-09 (Completed)</i>		
<i>Task 1</i>	<i>Completed</i>	<i>Memorandum/email that identifies Subject Matter Expert Subject Matter Expert resume</i>
<i>Task 2</i>	<i>Completed</i>	<i>1<sup>st</sup> Interim Report:</i> <ul style="list-style-type: none"> <li>- <i>List of studies of learning in general manufacturing</i></li> <li>- <i>List of studies of learning in mobile source manufacturing</i></li> <li>- <i>List of most relevant studies of learning in mobile source manufacturing</i></li> </ul>
<b>WA 3-09</b>		
Task 0	10 business days from work plan approval	Quality Assurance Project Plan (QAPP)
Task 2d	10 business days from work plan approval	Conference call with EPA to review EPA comments on 1 <sup>st</sup> Interim Report
Task 3	30 business days	2 <sup>nd</sup> Interim Report: <ul style="list-style-type: none"> <li>- Summaries of most relevant studies of learning in mobile source manufacturing</li> <li>- Summaries of studies representing an overview of learning in general manufacturing</li> <li>- Brief assessment of the state of the literature</li> </ul>
	10 business days	EPA review and comment on 2 <sup>nd</sup> Interim Report

Task 4	20 business days	3 <sup>rd</sup> Interim Report: <ul style="list-style-type: none"> <li>- Synthesis of each mobile source sector learning literature</li> <li>- Methodology to estimate learning effects in each mobile source sector</li> <li>- Estimate of learning effects in each mobile source sector</li> </ul>
	10 business days	EPA review and comment on 3 <sup>rd</sup> Interim Report
Task 5	20 business days	Draft final report: <ul style="list-style-type: none"> <li>- Description of identification of subject matter expert (Task 1)</li> <li>- 1<sup>st</sup> Interim report (Task 2)</li> <li>- 2<sup>nd</sup> Interim report (Task 3)</li> <li>- 3<sup>rd</sup> Interim report (Task 4)</li> </ul>
	20 business days	EPA review and comment on draft final report
Task 6	20 business days	Final Report <ul style="list-style-type: none"> <li>- Revisions as appropriate in response to EPA comments</li> </ul>

<b>EPA</b> United States Environmental Protection Agency Washington, DC 20460 <b>Work Assignment</b>						Work Assignment Number 3-10				
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:				
Contract Number EP-C-12-011			Contract Period   02/01/2012   To   09/30/2015 Base                      Option Period Number      3			Title of Work Assignment/SF Site Name Reduced Scale Wind Tunnel Test				
Contractor ICF INCORPORATED, L.L.C.					Specify Section and paragraph of Contract SOW Task 2a, 2b					
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval						Period of Performance  From   06/25/2015   To   09/30/2015				
Comments:										
<div style="display: flex; justify-content: space-between;"> <input type="checkbox"/> Superfund           Accounting and Appropriations Data           <input checked="" type="checkbox"/> Non-Superfund         </div>										
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.										
SFO (Max 2) <input type="checkbox"/>										
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										
Authorized Work Assignment Ceiling										
Contract Period:		Cost/Fee:			LOE:					
02/01/2012   To   09/30/2015										
This Action:										
Total:										
Work Plan / Cost Estimate Approvals										
Contractor WP Dated:				Cost/Fee:			LOE:			
Cumulative Approved:				Cost/Fee:			LOE:			
Work Assignment Manager Name   Arvon Mitcham  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number   734-214-4522 FAX Number:			
Project Officer Name   Greg Janssen  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number: 734-214-4285 FAX Number: 734-214-4821			
Other Agency Official Name  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number: FAX Number:			
Contracting Official Name   Sandra Savage  <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number: 513-487-2046 FAX Number:			

**PERFORMANCE WORK STATEMENT**

EPA Contract: EP-C-12-011

Work Assignment (WA): 3-10

Issuing Office: EPA Office of Transportation and Air Quality (OTAQ)  
2000 Traverwood Dr.  
Ann Arbor, Michigan 48105

Contractor: ICF International  
9300 Lee Highway  
Fairfax, VA 22031-1207

Statement of Work: Aerodynamic Trailer Component Assessment and  
Impact on the Green House Gas Emissions from  
Heavy-Duty Combination Vehicles: Follow-Up Reduced  
Scale Wind Tunnel Testing

Work Assignment Contract  
Officer Representative (WA COR): Arvon Mitcham  
2000 Traverwood Drive  
Ann Arbor, MI 48105  
734-214-4522  
mitcham.arvon@epa.gov

Alternate WA COR: Houshun Zhang  
2000 Traverwood Drive  
Ann Arbor, MI 48105  
734-214-4214  
zhang.houshun@epa.gov

**BACKGROUND**

On September 15, 2011, the United States Environmental Protection Agency (U.S. EPA) and the National Highway Traffic Safety Administration (NHTSA) published a final rulemaking establishing Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles (HD GHG Phase 1). This program was the first of its kind focused on reducing greenhouse gas (GHG) emissions and improving the fuel efficiency of heavy-duty trucks and buses; it is projected to reduce CO<sub>2</sub> emissions by about 270 million metric tons and save about 530 million barrels of oil over the life of model year 2014 to 2018 vehicles.

As part of this rulemaking effort, an emphasis was placed on reducing the aerodynamic drag of heavy-duty trucks, specifically Class 7 and 8 combination tractors. Class 7 and 8 combination tractors and their engines contribute the largest portion of the total GHG emissions and fuel consumption (approximately 65 percent) of the heavy-duty sector, due to their large payloads, their high annual miles traveled, and their major role in national freight transport. Based on empirical studies of Class 8 Tractors, a 1% improvement in aerodynamic drag equates to a 0.5% improvement in fuel economy, and consequently equates to lower GHG emissions for HD Class 8 Tractor-Trailer combinations. Therefore, reducing the amount of aerodynamic drag on a Class 7/8 combination tractor-trailer reduces the GHG emissions, fuel consumption, and overall operating cost for a Class 7/8 combination tractor.

EPA is developing a second phase of HD GHG regulations (HD GHG Phase 2). As done previously

in HD GHG Phase 1, reduction in aerodynamic drag on a Class 7/8 combination tractor-trailer will be a major focus. Specifically, EPA is considering including HD trailers as part of the rule to further increase fuel economy and lower GHG emissions from Class 7/8 Tractor-Trailer combinations. This allows EPA to take a systems approach by looking at the tractor-trailer combination as an entire vehicle, not just focusing on the Class 7/8 engine and tractor separately from the trailer. The inclusion of trailers should provide additional benefits in HD GHG Phase 2 and build on the success and achievements in HD GHG Phase 1.

## SCOPE

For HD GHG Phase 2, EPA seeks to evaluate: 1) the relationship between aerodynamic trailer devices and fuel consumption/CO<sub>2</sub> emissions, and 2) the cost-benefit of including trailers used with Class 7/8 tractors for HD GHG Phase 2. Determining the costs and potential benefits of aftermarket or original equipment trailer aerodynamic devices (e.g., side skirts, boat tails, and front trailer treatments) is required to improve vehicle aerodynamic performance and reduce GHG emissions of HD Class 7/8 Tractor-Trailer combinations.

To accomplish this, the various aerodynamic methods from HD GHG Phase 1 (e.g., coastdown, reduced scale wind tunnels) will be used to evaluate and characterize the performance of trailers and trailer aero technology and feed this into EPA's Greenhouse Gas Emissions Model (GEM)<sup>1</sup> to determine the potential GHG impact and output, and assist in HD GHG Phase 2 standard setting. This work assignment will require Reduced Scale Wind Tunnel Evaluation of 1/8<sup>th</sup> (12.5%) scale Class 7/8 Tractor-Trailer combinations with and without aerodynamic trailer devices installed, individually and in combination, to quantify the aerodynamic drag change from aerodynamic trailer devices.

In the event that the contractor estimates the required tasks will not be completed in the current period of performance, the contractor shall submit a work plan and cost proposal for the work that is anticipated to be completed during the current period of performance, and a separate work plan and cost proposal for the work that is anticipated to carry over into the next term. The contractor shall include the specific tasks and/or subtasks and corresponding timing for work to be completed during the current performance period and the carry-over work in the respective work plans.

## TASKS

The Contractor shall conduct Reduced Scale Wind Tunnel Testing (RSWT). The Contractor shall provide all required management, employee training, licensed personnel, permits, equipment, labor, materials, tools, personal protective equipment, and other items needed to accomplish each task. As novel and unexpected results may occur due to the nature of the work, the WA COR may provide technical direction via phone, email or in person followed-up with written technical direction during testing.

The Contractor shall conduct RSWT on detailed, in-house models of 1/8<sup>th</sup> (12.5%) scale Class 7/8 Tractor-Trailers as follows: four North American tractor OEMs (Navistar, PACCAR, Daimler, Volvo); three 53 foot dry box van trailer OEMs (Wabash, Great Dane, Hyundai); and the following aerodynamic trailer devices: Silver Eagle Aero Saber Trailer Skirt, ATDynamics Trailer Tail, and SmartTruck UT-1, UT-5 and Top Kit; for testing in different combinations to evaluate tractor/trailer/device aerodynamics. Additional technical detail on test scenario/case set-up is

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<sup>1</sup> EPA's Greenhouse Gas Emissions Model (GEM) is a free, desktop computer application that estimates the GHG emissions and fuel efficiency performance of specific aspects of heavy duty vehicles based on the manufacturer inputs of aerodynamic drag engine fuel map, tire rolling distance, weight reduction, and extended idle strategy for each tractor model in the manufacturer's fleet.

provided in Attachment A, "Detailed Test Plan for Wind Tunnel Testing." The Contractor shall furnish results of this task to the WA COR as they become available and shall include a summary of all results from this task in the final report.

The Contractor shall conduct reduced-scale wind tunnel evaluation of 1/8<sup>th</sup> (12.5%) scale Class 7/8 Tractor Trailer combination models, with and without aerodynamic trailer devices installed, individually and in combination, to quantify the aerodynamic drag change from aerodynamic trailer devices. The Contractor shall follow the test procedures and specifications described in 40 CFR Part 86.1037.521 using a reduced scale wind tunnel facility meeting the requirements in 40 CFR Part 86.1037.521. The wind tunnel facility shall have a rolling/moving floor and boundary layer reduction devices and both shall be active during the testing. In addition, the Contractor shall perform dual balance force isolation to identify the independent drag forces acting separately on the tractor and trailer, as well as the forces on the overall, combined tractor-trailer.

The Contractor shall include the following items in the technical report: the test process, all set-ups, test conditions including tunnel set-up, the measurement equipment and the mounting system, tractor and trailer model configuration, equipment, software used, data collection methods, descriptive photos of the baseline and all items tested with key setup elements, basic description of post processing methods and calculations, and discussion of any testing concerns or interferences, if applicable.

**Task 1: Follow-Up Wind Tunnel Evaluations of a 1/8<sup>th</sup> (12.5%) Scale Heavy Duty Class 7/8 Single Axle 4x2 Day Cab, Tandem Axle 6x4 Day Cab, and Class 8 High Roof Sleeper Cab Tractor-Trailer Testing to Support HD GHG Phase 2 Regulatory Development**

*Task 1a: Wind Tunnel Evaluation of 1/8<sup>th</sup> (12.5%) Scale Heavy Duty Class 7/8 Single Axle 4x2 Day Cab Tractor-Trailer*

The Contractor shall conduct reduced-scale wind tunnel evaluation of a 1/8<sup>th</sup> (12.5%) scale Class 7/8 2012 Navistar International ProStar High Roof Single Axle 4x2 Day Cab Tractor with the chassis skirts/fuel tank fairings removed in combination with a Wabash 53 foot dry box van trailer; with and without the following aerodynamic trailer devices installed: Silver Eagle Aero Saber Trailer Skirt, AT Dynamics Trailer Tail, and Laydon Composites Gap Reducer; individually and in different combinations to evaluate tractor/trailer/device aerodynamics. Additional technical detail on test scenario/case set-up and tractor model configuration is provided in Attachment A, "Detailed Test Plan for Wind Tunnel Testing," and "2012 Navistar International ProStar High Roof Single Axle Day Cab Settings," and Attachment B, "Individual Run Test Plan for Wind Tunnel Testing."

*Task 1b: Wind Tunnel Evaluation of 1/8<sup>th</sup> (12.5%) Scale Heavy Duty Class 7/8 Tandem Axle 6x4 Day Cab Tractor-Trailer*

The Contractor shall conduct reduced-scale wind tunnel evaluation of a 1/8<sup>th</sup> (12.5%) scale Class 7/8 2012 Navistar International ProStar High Roof Tandem Axle 6x4 Day Cab Tractor with a Wabash 53 foot dry box van trailer; with and without the following aerodynamic trailer devices installed: Silver Eagle Aero Saber Trailer Skirt, AT Dynamics Trailer Tail, and Laydon Composites Gap Reducer; individually and in different combinations to evaluate tractor/trailer/device aerodynamics. Additional technical detail on test scenario/case set-up and tractor model configuration is provided in Attachment A, "Detailed Test Plan for Wind Tunnel Testing" and Attachment B, "Individual Run Test Plan for Wind Tunnel Testing."



**Task 1c: *Advanced Trailer Device Combination' Wind Tunnel Evaluation of 1/8<sup>th</sup> (12.5%) Scale Heavy Duty Class 8 High Roof Sleeper Cab Tractor-Trailer***

The Contractor shall conduct reduced-scale wind tunnel evaluation of a 1/8<sup>th</sup> (12.5%) scale Class 8 2012 Navistar International ProStar High Roof Sleeper Cab Tractor with a Wabash 53 foot dry box van trailer; with and without the following aerodynamic trailer devices installed: Silver Eagle Aero Saber Trailer Skirt, AT Dynamics Trailer Tail, and Laydon Composites Gap Reducer, and SmartTruck UT-1, UT-5 and Top Kit; in different combinations to evaluate advanced tractor/trailer/device aerodynamics. Additional technical detail on test scenario/case set-up and tractor model configuration is provided in Attachment A, "Detailed Test Plan for Wind Tunnel Testing" and Attachment B, "Individual Run Test Plan for Wind Tunnel Testing."

**Task 2: *Wind Tunnel Evaluation of 1/8<sup>th</sup> (12.5%) Scale Heavy Duty Class 7/8 Tractor-Trailer Testing to Support SmartWay Technical Verification***

The Contractor shall conduct up to 36 hours of reduced-scale wind tunnel evaluation of a 1/8<sup>th</sup> (12.5%) scale Class 8 High Roof Sleeper Cab Tractor in combination with a 53 foot dry box van trailer; with and without aerodynamic trailer devices installed, including but not limited to: Silver Eagle Aero Saber Trailer Skirt, AT Dynamics Trailer Tail, and Laydon Composites Gap Reducer; individually and in different combinations to evaluate tractor/trailer/device aerodynamics. In addition, the Contractor shall conduct up to 24 hours of testing using a 48 foot trailer with a 1/8<sup>th</sup> scale Class 8 High Roof tractor, either in sleeper or day cab configuration to be determined and provided by the WA COR to the contractor. Additionally, the Contractor shall fabricate up to ten (10) trailer aerodynamic devices at 1/8<sup>th</sup> scale appropriate for use on the 48 foot trailer. The WA COR will provide the contractor with the list of specific trailer aerodynamic devices to be fabricated.

**DELIVERABLES**

**1. Kick-off Meeting**

Within one week after the WA is issued, but prior to the Contractor submitting a Work Plan, the Contractor shall discuss this work assignment with the WA COR to ensure a common understanding of the requirements, expectations, and ultimate end products.

**2. Develop Quality Assurance Project Plan**

The Contractor shall submit a draft QAPP to the WA COR within 15 days of Work Plan approval. The QAPP shall detail data collection and analysis tasks and procedures for this work assignment. The WA COR shall review and comment on the draft QAPP. The Contractor shall incorporate recommended changes and suggestions received from the WA COR and shall submit a final QAPP within 15 days after receipt of EPA comments. Guidance can be found at: QAPP for use of existing data: <http://www.epa.gov/quality/qs-docs/found-data-qapp-rqts.pdf>; Assessment Factors for relevance, applicability, utility of existing data: <http://www.epa.gov/spc/pdfs/assess2.pdf>; and EPA Requirements for QAPPs: <http://www.epa.gov/quality/qs-docs/r5-final.pdf>.

The final QAPP shall cover all aspects of this test program as outlined on the EPA quality website. The QAPP shall have an appendix containing all applicable standard operating procedures (SOPs). The Contractor shall adhere to all applicable SOPs and the QA procedures recommended therein. The Contractor shall notify the WA COR immediately if they encounter any equipment failures that cannot be remedied, problems that may impact the quality or on-time receipt of deliverables, or unavailability of items required for this work assignment.

### 3. Regular Progress Reports

The Contractor shall provide the WA COR with regular status reports via telephone conference or email during the period of performance. The frequency of the progress report can be adjusted as weekly or bi-weekly depending on the progress of the program. The progress report shall indicate the progress achieved in the concluded weeks, technical problems encountered, solutions to those problems, and projected activity for the upcoming weeks. Before proceeding with any solution to a problem, the Contractor shall report the problem and consult with the WA COR concerning the scope of the solution.

### 4. Technical Reports

The Contractor shall provide the WA COR with a brief Technical Report upon completion of each task. Depending on the complexity of the subject matter and as directed via written technical direction by the WA COR, these reports shall be in the form of either a presentation or a formal written document. Written products shall be delivered in formats specified by the WA COR (e.g., Word, Excel). For Task 1, the Contractor shall also provide a generic, public version of the technical report with references to tractor model, trailer model, and aerodynamic device model names removed in the data section (e.g., these details can be included in the background section of the report but should be removed in the data/result tables to prevent any bias on a particular manufacturers product).

### 5. Data

The Contractor shall provide the WA COR with raw test data within 5 days of completion of the Contractor's quality control review and approval for such data. The Contractor shall provide to the WA COR valid test data from a vehicle (per task) within 14 days of completion of the testing on the vehicle. All data shall be presented in Excel format.

### 6. Draft and Final Reports

The Contractor shall provide to the WA COR a Draft Final Report and data set summarizing the results of all tasks within 15 days of completion of the laboratory and modeling work contained in this work assignment. The Contractor shall deliver the Final Report within 15 days of receipt of comments from the WA COR. All reports and associated materials (e.g., data sets) shall be provided in formats specified by the WA COR.

## **SCHEDULE OF DELIVERABLES**

<b>Deliverable</b>	<b>Completion Date</b>
Kick-off Meeting (as necessary based on direction from the WA COR)	Within 1 week of receipt of work assignment
QAPP submission	Within 15 days of receipt of Work Plan approval
Final QAPP	Within 15 days of receiving EPA comments
Complete Tasks 1a-1c	On or before August 1, 2015
Complete Task 2	On or before September 1, 2015
Draft Final Report	Within 15 days of completion of all tasks
Final Report	On or before September 30, 2015

## **NON-DISCLOSURE AGREEMENT**

All documentation acquired and/or provided by EPA or generated as a result of this project shall be under the control of the U.S. EPA Assistant Administrator for Air and Radiation, or his or her designated representative, and shall not be released by the Contractor to any other source without specific approval by U.S. EPA.

# ATTACHMENT A

## DETAILED TEST PLAN FOR REDUCED-SCALE WIND TUNNEL TESTING

### Detailed Test Plan for Task 1a: Heavy Duty Class 7/8 Single Axle 4x2 Day Cab Tractor-Trailer: Reduced-Scale Wind Tunnel Evaluation of 1/8<sup>th</sup> (12.5%) Scale Class 7/8 Tractor-Trailer Combinations with and without Aerodynamic Trailer Devices

Tractors (n=4)	Trailers (n=3)	Devices (individually and combined, n=7)	Bogey Position	Tractor to Trailer Gap in inches	King Pin Setting	Trailer Radius	Trailer Ride Height Front/ Leading Edge	Trailer Ride Height Rear/ Trailing Edge	Trailer Test Weight
2012 Navistar International ProStar High Roof Single Axle 4x2 Day Cab w/: 1) chassis skirts /fuel tank fairings, 2) cab side extenders, and 3) roof fairing removed (See next page)	2008/09 Wabash	None (Base Trailer)	40'	45"	36"	5"	13'6"	13'6"	Empty
		Silver Eagle Aero Saber Trailer Skirt	40'	45"	36"	5"	13'6"	13'6"	Empty
		AT Dynamics Trailer Tail	40'	45"	36"	5"	13'6"	13'6"	Empty
		Silver Eagle Aero Saber Trailer Skirt + AT Dynamics Trailer Tail	40'	45"	36"	5"	13'6"	13'6"	Empty

Trailer: All trailers must be 53' dry box vans with swing doors, king pin at 36", front corner radius 5" with air ride.

Yaw Map: All testing to be done with full yaw sweeps of 0, -9, -6, -3, -1, 0, +1, +3, +6, +9, 0 and wind average drag calculations at calculations at all speeds between 55-75 mph in increments of 10 mph (e.g., 55, 65, 75). Alternatively, a half yaw sweep (0, +1, +3, +6, +9) or 0, +/-6 may be used to develop the yaw sweep.

Tractor-Trailer Specifications: California position of a standard bogey is defined as 40' from the center of the king pin to the center of the rear most axle on the trailer. Tractor-trailer gap is 45 inches and is defined as and measured from the rear of the tractor to the front of the trailer.

Test Procedure Specifications: All reduced-scale wind tunnel testing shall be performed using the test procedure described in §1037.521(d) of Title 40 to obtain estimates of aerodynamic drag, unless otherwise specified.

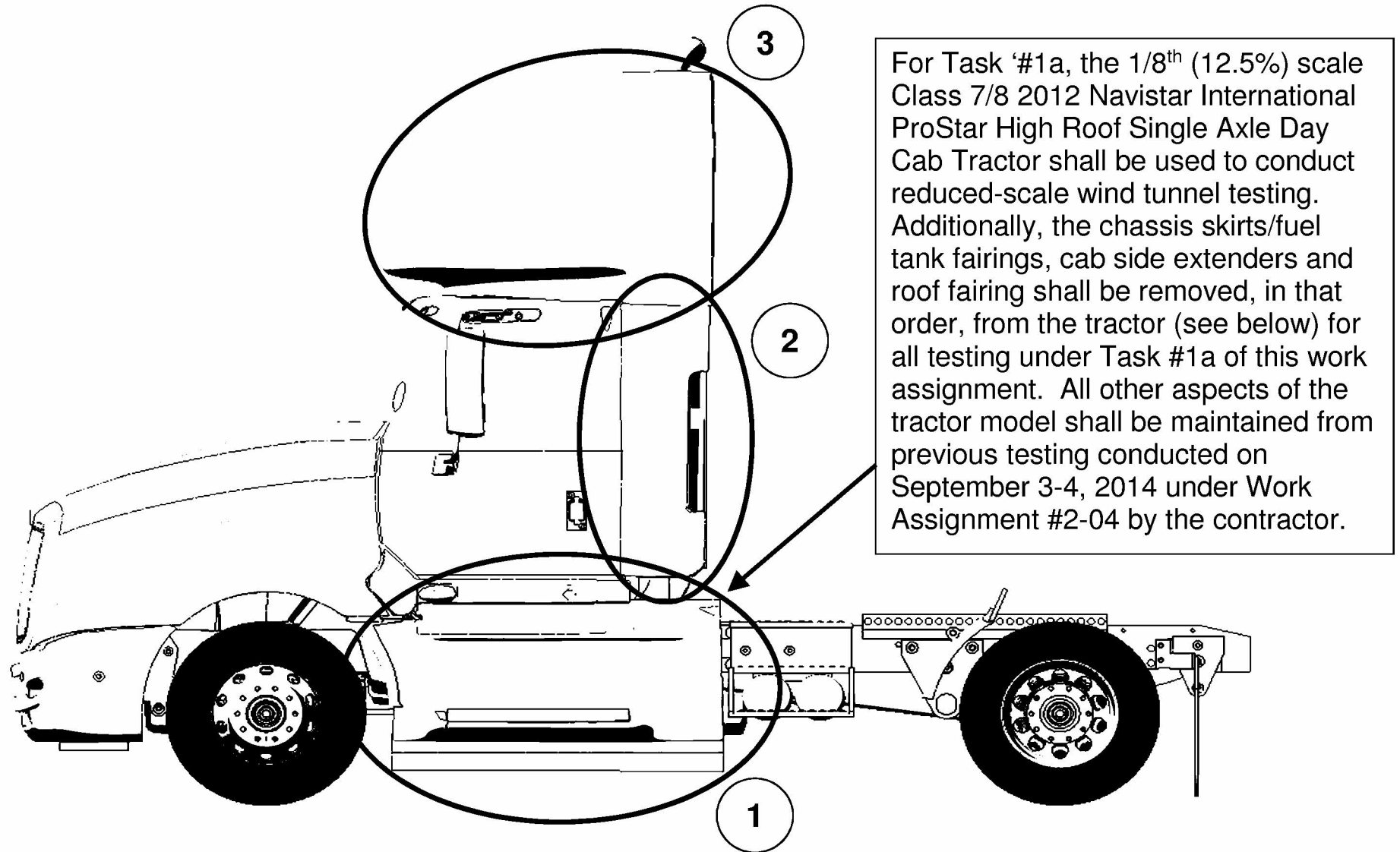
All testing shall be performed with a dual balance load cell to capture the aerodynamic drag split between tractor and trailer.

All test parameters (e.g., Reynolds number, wind speed, simulated vehicle speed, humidity, temperature, pressures, any correction factors) shall be collected and provided for each test to ensure accuracy, repeatability and validity.

All testing shall be consistent with 40 CFR §86.1037.521.

## ATTACHMENT A

### 2012 NAVISTAR INTERNATIONAL PROSTAR HIGH ROOF SINGLE AXLE DAY CAB SETTINGS



# ATTACHMENT A

## DETAILED TEST PLAN FOR REDUCED-SCALE WIND TUNNEL TESTING

### Detailed Test Plan for Task 1b: Heavy Duty Class 7/8 Tandem Axle 6x4 Day Cab Tractor-Trailer: Reduced-Scale Wind Tunnel Evaluation of 1/8<sup>th</sup> (12.5%) Scale Class 7/8 Tractor-Trailer Combinations with and without Aerodynamic Trailer Devices

Tractors (n=4)	Trailers (n=3)	Devices (individually and combined, n=7)	Bogey Position	Tractor to Trailer Gap in inches	King Pin Setting	Trailer Radius	Trailer Ride Height Front/ Leading Edge	Trailer Ride Height Rear/ Trailing Edge	Trailer Test Weight
2012 Navistar International ProStar High Roof Tandem Axle 6x4 Day Cab	2008/09 Wabash	None (Standard Trailer)	40'	45"	36"	5"	13'6"	13'6"	Empty
		Silver Eagle Aero Saber Trailer Skirt	40'	45"	36"	5"	13'6"	13'6"	Empty
		Ridge Green Wing Trailer Skirt	40'	45"	36"	5"	13'6"	13'6"	Empty
	2008/09 Great Dane	AT Dynamics Trailer Tail	40'	45"	36"	5"	13'6"	13'6"	Empty
		Laydon Composites Gap Reducer	40'	45"	36"	5"	13'6"	13'6"	Empty
	2008/09 Hyundai Translead	Silver Eagle Aero Saber Trailer Skirt + AT Dynamics Trailer Tail	40'	45"	36"	5"	13'6"	13'6"	Empty
		Silver Eagle Aero Saber Trailer Skirt + AT Dynamics Trailer Tail + Laydon Composites Gap Reducer	40'	45"	36"	5"	13'6"	13'6"	Empty

Trailer: All trailers must be 53' dry box vans with swing doors, king pin at 36", front corner radius 5" with air ride.

Yaw Map: All testing to be done with full yaw sweeps of 0, -9, -6, -3, -1, 0, +1, +3, +6, +9, 0 and wind average drag calculations at calculations at all speeds between 55-75 mph in increments of 10 mph (e.g., 55, 65, 75). Alternatively, a half yaw sweep (0, +1, +3, +6, +9) or 0, +/-6 may be used to develop the yaw sweep.

Tractor-Trailer Specifications: California position of a standard bogey is defined as 40' from the center of the king pin to the center of the rear most axle on the trailer. Tractor-trailer gap is 45 inches and is defined as and measured from the rear of the tractor to the front of the trailer.

Test Procedure Specifications: All reduced-scale wind tunnel testing shall be performed using the test procedure described in §1037.521(d) of Title 40 to obtain estimates of aerodynamic drag, unless otherwise specified.

All testing shall be performed with a dual balance load cell to capture the aerodynamic drag split between tractor and trailer.

All test parameters (e.g., Reynolds number, wind speed, simulated vehicle speed, humidity, temperature, pressures, any correction factors) shall be collected and provided for each test to ensure accuracy, repeatability and validity.

All testing shall be consistent with 40 CFR §86.1037.521.

# ATTACHMENT A

## DETAILED TEST PLAN FOR REDUCED-SCALE WIND TUNNEL TESTING

### Detailed Test Plan for Task 1c, Heavy Duty Class 8 High Roof Sleeper Cab Tractor-Trailer: Reduced-Scale Wind Tunnel Evaluation of 1/8<sup>th</sup> (12.5%) Scale Class 7/8 Tractor-Trailer Combinations using Advanced Trailer Device Combinations

Tractors (n=4)	Trailers (n=3)	Devices (individually and combined, n=7)	Bogey Position	Tractor to Trailer Gap in inches	King Pin Setting	Trailer Radius	Trailer Ride Height Front/ Leading Edge	Trailer Ride Height Rear/ Trailing Edge	Trailer Test Weight
2012 Navistar International ProStar High Roof Sleeper Cab	2008/09 Wabash	None (Base Trailer)	40'	45"	36"	5"	13'6"	13'6"	Empty
		Silver Eagle Aero Saber Trailer Skirt + AT Dynamics Trailer Tail + Laydon Gap Reducer	40'	45"	36"	5"	13'6"	13'6"	Empty
		Add SmartTruck UT-1 to configuration above	40'	45"	36"	5"	13'6"	13'6"	Empty
		Add SmartTruck UT-5 to configuration above	40'	45"	36"	5"	13'6"	13'6"	Empty
		Add SmartTruck Top Rain Gutter to configuration above (UT-6)	40'	45"	36"	5"	13'6"	13'6"	Empty
		Add SmartTruck Side Gutters to configuration above (UT-6 plus)	40'	45"	36"	5"	13'6"	13'6"	Empty
		Decrease Tractor Trailer Gap	40'	<u>40"</u>	36"	5"	13'6"	13'6"	Empty

Trailer: All trailers must be 53' dry box vans with swing doors, king pin at 36", front corner radius 5" with air ride.

Yaw Map: All testing to be done with full yaw sweeps of 0, -9, -6, -3, -1, 0, +1, +3, +6, +9, 0 and wind average drag calculations at calculations at all speeds between 55-75 mph in increments of 10 mph (e.g., 55, 65, 75). Alternatively, a half yaw sweep (0, +1, +3, +6, +9) or 0, +/-6 may be used to develop the yaw sweep.

Tractor-Trailer Specifications: California position of a standard bogey is defined as 40' from the center of the king pin to the center of the rear most axle on the trailer. Tractor-trailer gap is 45 inches and is defined as and measured from the rear of the tractor to the front of the trailer.

Test Procedure Specifications: All reduced-scale wind tunnel testing shall be performed using the test procedure described in §1037.521(d) of Title 40 to obtain estimates of aerodynamic drag, unless otherwise specified.

All testing shall be performed with a dual balance load cell to capture the aerodynamic drag split between tractor and trailer.

All test parameters (e.g., Reynolds number, wind speed, simulated vehicle speed, humidity, temperature, pressures, any correction factors) shall be collected and provided for each test to ensure accuracy, repeatability and validity.

All testing shall be consistent with 40 CFR §86.1037.521.

# ATTACHMENT B

## INDIVIDUAL RUN TEST PLAN FOR REDUCED-SCALE WIND TUNNEL TESTING, TASKS 1A-1C

Test Date = Prior to August 15, 2015					
Trailer	Change Description	All times in <i>Minutes</i> unless specified			Hours Run
		Run Time	Change Time	Cummulative Time	
Wabash	First Run: 4x2 Day Cab Tractor Fuel Tank Fairings/Chassis Skirts removed (Task 1A)	22	0	22	0.366666667
Wabash	Repeat	22	0	44	0.733333333
Wabash	Repeat	22	0	66	1.1
Wabash	Silver Eagle Aero Saber Trailer Skirt	22	14	102	1.7
Wabash	Add AT Dynamics Trailer Tail	22	16	140	2.333333333
Wabash	Remove Silver Eagle Aero Saber Trailer Skirt + AT Dynamics Trailer Tail	22	20	182	3.033333333
Wabash	Repeat	22	0	204	3.4
Wabash	Remove Tractor Side Extenders/Gap Fairings	22	40	266	4.433333333
Wabash	Repeat	22	0	288	4.8
Wabash	Repeat	22	0	310	5.166666667
Wabash	Repeat	22	0	332	5.533333333
Wabash	Remove Tractor Roof Fairing	22	40	394	6.566666667
Wabash	Repeat	22	0	416	6.933333333
Wabash	Repeat	22	0	438	7.3
Wabash	Repeat	22	0	460	7.666666667
Wabash	Change Tractor: Navistar ProStar High Roof Sleeper Cab (Task 1C)	22	90	572	9.533333333
Wabash	Repeat	22	0	594	9.9
Wabash	Repeat	22	0	616	10.266666667
Wabash	Add Silver Eagle Aero Saber Trailer Skirt + AT Dynamics Trailer Tail + Laydon Composites Gap Reducer	22	25	663	11.05
Wabash	Add SmartTruck UT-1	22	16	701	11.683333333
Wabash	Add SmartTruck UT-5	22	16	739	12.316666667
Wabash	Add SmartTruck UT-6 (Top Rain Gutter added to UT-1 and UT-5)	22	16	777	12.95
Wabash	Add SmartTruck UT-6+ (Side trailer pieces added to UT-6)	22	16	815	13.583333333
Wabash	Decrease Tractor-Trailer Gap (45" => 40")	22	25	862	14.366666667
Wabash	Repeat: Remove all devices, Return Gap to 45"	22	15	899	14.983333333
		days @ 8-hour shifts per day (approximately)			1.9
		Exact timing			14 hours, 59 minutes

# ATTACHMENT B

## INDIVIDUAL RUN TEST PLAN FOR REDUCED-SCALE WIND TUNNEL TESTING, TASKS 1A-1C

Test Date = Prior to August 15, 2015					
Trailer	Change Description	Run Time	Change Time	Cummulative Time	Hours Run
Wabash	First Run: 6x4 Day Cab Tractor w/ Wabash Trailer	22	0	22	0.366666667
Wabash	Repeat	22	0	44	0.733333333
Wabash	Repeat	22	0	66	1.1
Wabash	Ridge Green Wing Trailer Skirt	0	14	80	1.333333333
Wabash	Silver Eagle Aero Saber Trailer Skirt	22	14	116	1.933333333
Wabash	Add AT Dynamics Trailer Tail	22	16	154	2.566666667
Wabash	Add Laydon Composites Gap Reducer	0	16	170	2.833333333
Wabash	Remove Silver Eagle Aero Saber Trailer Skirt + AT Dynamics Trailer Tail	22	14	206	3.433333333
Wabash	Remove Laydon Composites Gap Reducer	0	14	220	3.666666667
Wabash	Repeat	22	0	242	4.033333333
Great Dane	Change Trailer: Great Dane	22	60	324	5.4
Great Dane	Repeat	22	0	346	5.766666667
Great Dane	Repeat	22	0	368	6.133333333
Great Dane	Ridge Green Wing Trailer Skirt	0	14	382	6.366666667
Great Dane	Silver Eagle Aero Saber Trailer Skirt	0	14	396	6.6
Great Dane	Add AT Dynamics Trailer Tail	0	16	412	6.866666667
Great Dane	Add Laydon Composites Gap Reducer	0	16	428	7.133333333
Great Dane	Remove Silver Eagle Aero Saber Trailer Skirt + AT Dynamics Trailer Tail	0	14	442	7.366666667
Great Dane	Remove Laydon Composites Gap Reducer	0	14	456	7.6
Great Dane	Repeat	22	0	478	7.966666667
Hyundai	Change Trailer: Hyundai Translead	22	60	560	9.333333333
Hyundai	Repeat	22	0	582	9.7
Hyundai	Repeat	22	0	604	10.066666667
Hyundai	Ridge Green Wing Trailer Skirt	0	14	618	10.3
Hyundai	Silver Eagle Aero Saber Trailer Skirt	0	14	632	10.533333333
Hyundai	Add AT Dynamics Trailer Tail	0	16	648	10.8
Hyundai	Add Laydon Composites Gap Reducer	0	16	664	11.066666667
Hyundai	Remove Silver Eagle Aero Saber Trailer Skirt + AT Dynamics Trailer Tail	0	14	678	11.3
Hyundai	Remove Laydon Composites Gap Reducer	0	14	692	11.533333333
Hyundai	Repeat	22	0	714	11.9
		days @ 8-hour shifts per day (approximately)			1.5
		Exact timing			11 hours, 54 minutes



<b>EPA</b> United States Environmental Protection Agency Washington, DC 20460 <b>Work Assignment</b>						Work Assignment Number 3-11				
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:				
Contract Number EP-C-12-011			Contract Period 02/01/2012 To 09/30/2015			Title of Work Assignment/SF Site Name				
			Base                      Option Period Number    3			Analysis Ambient Air Lead Conc				
Contractor ICF INCORPORATED, L.L.C.					Specify Section and paragraph of Contract SOW Task 7a					
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval					Period of Performance  From 07/30/2015 To 09/30/2015					
Comments:										
<input type="checkbox"/> Superfund                      Accounting and Appropriations Data <input checked="" type="checkbox"/> Non-Superfund										
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.										
SFO (Max 2) <input type="checkbox"/>										
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										
Authorized Work Assignment Ceiling										
Contract Period:		Cost/Fee:			LOE:					
02/01/2012 To 09/30/2015										
This Action:										
Total:										
Work Plan / Cost Estimate Approvals										
Contractor WP Dated:				Cost/Fee:			LOE:			
Cumulative Approved:				Cost/Fee:			LOE:			
Work Assignment Manager Name Christy Parsons							Branch/Mail Code:			
_____ (Signature)                      (Date)							Phone Number 734-214-4243			
							FAX Number:			
Project Officer Name Greg Janssen							Branch/Mail Code:			
_____ (Signature)                      (Date)							Phone Number: 734-214-4285			
							FAX Number: 734-214-4821			
Other Agency Official Name Christina Powers							Branch/Mail Code:			
_____ (Signature)                      (Date)							Phone Number: 919-541-5504			
							FAX Number:			
Contracting Official Name Sandra Savage							Branch/Mail Code:			
_____ (Signature)                      (Date)							Phone Number: 513-487-2046			
							FAX Number:			

## PERFORMANCE WORK STATEMENT

**Title:** Analysis of Ambient Air Lead Concentrations Monitored Near Airports in the Lead Surveillance Network, Collection of Meteorological Data, and Analysis of Nationwide Aircraft Fleet

**Contractor:** ICF International  
9300 Lee Highway  
Fairfax, VA 22031-1207

**Work Assignment Contracting Officer**

**Representative (WA COR):** Christy Parsons  
Tel: 734-214-4243  
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**Alternate WA COR:** Meredith Pedde  
Tel: 734-214-4748  
Email: [pedde.meredith@epa.gov](mailto:pedde.meredith@epa.gov)

**Period of Performance:** Issue Date – September 30, 2015

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### I. Background

Tetraethyl lead is used as an additive in aviation fuel for most piston-engine powered aircraft. Lead (Pb) emissions from the use of leaded aviation gasoline (avgas) accounts for over half of the air emission inventory for lead. EPA has been petitioned to conduct an investigation to evaluate whether aircraft lead emissions cause or contribute to air pollution that may reasonably be anticipated to endanger the public health or welfare.

### II. Purpose

This work assignment supports EPA's continued investigation and study of lead emitted by piston-engine aircraft and potential impacts on air quality. This work assignment includes the use of data collected by the contractor in two previous work assignments: Work Assignment No. 0-10 under EPA contract EP-C-12-011 ("Recording Aircraft Operations at General Aviation Airports with Lead Monitors") and Work Assignment No. 3-66 under EPA contract EP-C-09-009 ("Ambient Lead Concentrations from Piston-engine Aircraft"). However, the contractor shall not duplicate any work previously performed.

The current work assignment requires contractor services on the following tasks: Task 1 conduct quantitative analyses of the relationship between monitored ambient lead concentrations at airports and variables that impact ambient air lead concentrations (e.g., concentration of lead in avgas, number of aircraft operations); Task 2, collect meteorological data for January 1, 2014 through March 1, 2015; Task 3, compare the composition of the piston aircraft fleet at the Reid-

Hillview airport (RHV) with the national piston aircraft fleet. Each of these tasks is described in detail below, along with deliverables associated with each task.

### **III. Statement of Work**

#### **A. Scope**

The purpose of this work assignment is to provide assistance to EPA/OTAQ/ASD in evaluating whether aircraft lead emissions cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare. Secondary objectives are included and described in the specific tasks enumerated below.

#### **B. Specific Requirements**

The Contractor shall provide periodic updates by phone or email with the WA COR on at least a monthly basis, indicating progress, questions, or problems with the project. Any questions or requests received from the WA COR by phone or email shall receive a response within one business day.

The contractor shall prepare a Quality Assurance Project Plan (QAPP). The QAPP provided to EPA under Work Assignments No. 0-10 and 1-10 under EPA contract EP-C-12-011 and Work Assignment No. 3-66 under EPA contract EP-C-09-009 may be used as a starting point to satisfy the QAPP requirements for this work assignment. The contractor shall update this QAPP to account for any new tasks included in this work assignment. The contractor shall not commence work involving environmental generation data or use until the WA COR has approved the QAPP.

#### **C. Tasks**

##### **Task 1: Analysis of Ambient Air Lead Concentrations Monitored Near Airports in the Lead Surveillance Network.**

The contractor shall provide EPA with quantitative analyses of the relationship between monitored concentrations of lead in ambient air at airports and the variables that impact concentration (e.g., number of aircraft operations, duration of run-up operation mode, concentration of lead in avgas, wind direction, wind speed, temperature and distance between the monitor and the run-up location). These analyses shall include 1) univariate and multivariate equations, and 2) airport-specific air quality impact factors expressed as concentrations of lead in micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) per operation.

Subtasks 1.1 – 1.5 below describe the data the contractor shall collect and analyze in order to conduct these two types of analyses (univariate/multivariate equations and air quality impact factors). Specifically, these data will serve as the input variables needed to quantitatively evaluate the factors that impact monitored lead concentrations at airports. Subtasks 1.6 and 1.7 then describe how the contractor shall conduct both types of analysis. Subtask 1.8 describes the specific spreadsheets that the contractor shall provide to EPA as deliverables. Finally, Subtask 1.9 outlines parameters for a summary report on the work completed in the previous subtasks.

EPA will provide the following information for the contractor to conduct the work described in Task 1:

- 1) The list of airports that shall be the focus of the analysis in Task 1 (Table 1). The airports included in this analysis are those in the lead National Ambient Air Quality Standards (NAAQS) surveillance network that meet the following three criteria: i) the lead monitor was located immediately adjacent to or downwind from the maximum impact area<sup>1</sup>, ii) on-site activity counts for piston-engine aircraft are available from Work Assignment No. 0-10 under EPA contract EP-C-12-011 (“Recording Aircraft Operations at General Aviation Airports with Lead Monitors”), and iii) daily on-site aircraft activity traffic counts for General Aviation (GA) and Air Taxi (AT) operations are provided in FAA’s Air Traffic Activity Database (ATADS).
- 2) An Excel file that contains individual worksheets for each airport listed in Table 1. Each worksheet contains the 24-hour monitored lead concentrations along with the corresponding GA and AT daily operations data that EPA has extracted from FAA’s ATADS. The data are provided through the time periods noted immediately below. Details on monitor siting are also provided.
  - a. CRQ was monitored at the relevant location in ambient air downwind from piston aircraft operations from March 2012 through March 2013. Beginning in November 2014 data is being collected from a location distant from aircraft activity and therefore shall not be analyzed by the contractor for the purposes of this task.
  - b. MRI was monitored at the relevant location in ambient air downwind from piston aircraft operations from October 2011 through October 2012.
  - c. PAO was monitored at the relevant location in ambient air downwind from piston aircraft operations from February 2012 through December 2014. The monitor is being re-located, however the contractor shall not analyze data from the re-located site.
  - d. The RHV monitoring location has remained consistent throughout the sampling period and monitoring is currently ongoing; monitoring began in February 2012.
  - e. At SQL the relationship between lead concentration and activity shall be analyzed in two separate periods: a) for the first period from March 20, 2012 through May 28, 2013 co-located monitors were adjacent to aircraft conducting their run-up pre-flight checks, b) for the second period from June 3, 2013 through September 13, 2013 the run-up location was moved approximately 60 meters upwind from the monitoring location.
  - f. At VNY the relationship between lead concentration and activity shall be analyzed in two separate periods: a) for the period from November 5, 2011 through June 3, 2013 when the lead monitor was adjacent to aircraft conducting their run-up pre-flight checks on runway 16L and, b) for the period from January 2, 2010 through October 30, 2011 when the lead monitor was approximately 70 meters north of the other monitor location. Monitoring at this airport ceased on June 3, 2013.

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<sup>1</sup> At airports these areas are located in closest proximity to the run-up and take-off location.

- 3) All available fuel lead concentration data collected at the airports are listed in Table 1 (average of 2.14 grams lead per gallon). These data are not available for 4 of the 6 listed airports. For airports lacking fuel lead concentration data, the contractor shall use the maximum lead concentration specified by ASTM for 100LL of 2.12 grams per gallon. For the two airports with avgas fuel concentration data, the contractor shall use the airport average of the collected samples (i.e., 2.11 g/gal at PAO and 2.16 g/gal at RHV).

**Table 1. Airports that are the Focus for Analysis in Task 2**

<b>Airport Name</b>	<b>City, State</b>	<b>AQS Monitor Number</b>	<b>Runway End Proximate to the Lead Monitor</b>	<b>Avgas Pb Concentrations (g/gal)</b>
<b>McClellan-Palomar (CRQ)</b>	Carlsbad, CA	06-073-1020-1	24	-
<b>Merrill Field (MRI)</b>	Anchorage, AK	02-020-0051-1	25	-
<b>Palo Alto (PAO)</b>	Palo Alto, CA	06-085-2010-3	31	Rossi Aircraft: 2.02 Palo Alto Fuel Service: 2.19
<b>Reid-Hillview (RHV)</b>	San Jose, CA	06-085-2011-3	31R	Nice Air: 2.13 Aerodynamic Aviation: 2.21 San Jose Air: 2.14
<b>San Carlos (SQL)</b>	San Carlos, CA	06-081-2002-3	30	-
<b>Van Nuys (VNY)</b>	Van Nuys, CA	06-037-1402-1	16L	-

Subtask Descriptions:

*1.1 Calculate aircraft activity*

To evaluate how the lead concentrations monitored at airports vary by aircraft activity, the contractor shall allocate the total number of piston GA and AT operations into four categories: 1) single-engine full cycle operations, 2) multi-engine full cycle operations, 3) single-engine touch-and-go (T&G) operations, and 4) multi-engine T&G operation. Airports may also experience extensive piston-engine helicopter activity, the contractor shall consult with the WA COR to determine if these rotorcraft activity will be estimated for this work. The total number of operations in each of the designated categories is needed in each 24-hour period in which lead concentrations were monitored. The specific steps for calculating activity in each of these categories are detailed in task 1.1.1 below.

*1.1.1 Calculate piston-engine specific activity*

The contractor shall fraction out the portion of GA and AT activity conducted by piston-engine powered aircraft. To estimate the fraction of GA and AT activity conducted by piston-engine aircraft, the contractor shall query available sources

of information, including a) the airport's website, b) the airport's master plan, c) information supplied on [www.airnav.com](http://www.airnav.com) regarding the airport-specific fraction of based aircraft that are single and multi-engine compared with jet engine, and d) the fraction of activity conducted by piston-engine aircraft as observed in Work Assignment No. 0-10 under EPA contract EP-C-12-011 ("Recording Aircraft Operations at General Aviation Airports with Lead Monitors") and in Work Assignment No. 3-66 under EPA contract EP-C-09-009 ("Ambient Lead Concentrations from Piston-engine Aircraft") for the Reid-Hillview airport. After collecting information from each of these data sources, the contractor shall consult with the WA COR to identify a data source(s) for each airport that provides the best estimate of the fraction of GA and AT activity that is conducted by piston-engine aircraft. The contractor shall identify if the piston-engine fractions differ by aircraft type (i.e., single- vs. multi-engine) and activity type (full cycle vs. T&G). The contractor shall propose a data source(s) for each airport along with a justification for why the selected source(s) is the best option for each airport. The contractor shall then use this information in the subsequent analyses in this task.

The contractor shall evaluate whether any of the operations that were categorized by the FAA tower as AT operations in ATADS were conducted by piston-engine aircraft. Specifically, the contractor shall propose whether any piston operations were categorized as AT with appropriate rationale for WA COR review. AT operations are typically conducted by aircraft that can seat over 8 people. The contractor shall use data collected in Work Assignment No. 0-10 under EPA contract EP-C-12-011 ("Recording Aircraft Operations at General Aviation Airports with Lead Monitors") to evaluate whether any aircraft observed could be categorized as conducting AT operations.

The contractor shall use the airport-specific fraction of GA and AT activity conducted by piston-engine aircraft for all days of analysis (i.e., the fraction of activity conducted by piston-powered aircraft will not vary by day at an individual airport but may vary from airport-to-airport). Using these fractions and the daily GA and AT operations from FAA's ATADS, the contractor shall calculate the daily operations conducted by single and multi-engine piston aircraft (separately for full cycle and T&G) at each airport in Table 1 for each day on which lead concentrations were monitored. Data from this task shall be included in the Primary Analysis Spreadsheet deliverable, described below in subtask 1.8.1.

## *1.2 Collect and analyze meteorological data*

In addition to the calculation of piston-engine aircraft activity described in Subtask 1.1, wind direction and other meteorological data are necessary to evaluate the impact of aircraft activity on monitored lead concentrations at airports. This subtask and Subtask 1.3 require evaluation of hourly data since both meteorology and activity (the topic of Subtask 1.3) can vary strongly in a 24-hour period and the evaluation of the impact of aircraft activity on the monitored concentrations shall focus on aircraft operations conducted upwind from the monitor. Specifically, the contractor shall collect and use

wind direction data to calculate the number of total operations (full cycle + T&G) that occur at the runways identified in Table 1 on each monitoring day at each airport. This subtask describes the collection and evaluation of wind direction and other necessary meteorological data.

*1.2.1 Collect wind and temperature data*

The contractor shall collect hourly wind speed, wind direction, and temperature data for each airport identified in Table 1 on the days for which lead monitoring data shall be evaluated (i.e., the days described above). The source of the wind speed and wind direction data shall include any on-site measurements made as part of Work Assignment No. 0-10 under EPA contract EP-C-12-011 (“Recording Aircraft Operations at General Aviation Airports with Lead Monitors”), but the majority of meteorological data shall be downloaded from the nearest ASOS station. The contractor shall provide a spreadsheet (described below in subtask 1.8.2) to EPA in which each airport’s hourly wind speed, wind direction, and temperature data for each day of air lead monitoring is provided in a separate tab/worksheet.

*1.2.2 Analyze wind direction data*

The contractor shall determine at each airport, for each hour of each monitored day, whether piston-engine aircraft activity occurred on the runway in closest proximity to the lead monitor (given that aircraft take off into the wind). The wind directions that would compel the use of the runways listed in Table 1 shall include wind directions from all headings that are perpendicular to or create a headwind for aircraft departing or landing. For example, the contractor shall assume that aircraft leaving San Carlos airport would use runway 30 if the wind direction was coming from 300 degrees plus 90 degrees, through 300 degrees minus 90 degrees on the compass; this would include wind directions from 0-30 degrees and 210-360 degrees.

*1.2.3 Calculate wind speed averages and ranges*

Wind speed data shall be analyzed at each airport for each 24-hr monitoring period for only the hours when the airport was open to determine if wind speed has an impact on the concentrations of lead monitored (subtask 1.6 below). The average, minimum, and maximum wind speeds at each airport for the airport open hours during each monitored day shall be calculated and included in the Primary Analysis Spreadsheet deliverable, described below in subtask 1.8.1.

*1.2.4 Calculate average temperature data*

Average temperature data shall be analyzed at each airport for each 24-hour monitoring period for only the hours when the airport was open to determine if temperature has an impact on the concentrations of lead monitored (subtask 1.6 below). The average temperature at each airport for the airport open hours during each monitored day shall be calculated and included in the Primary Analysis Spreadsheet deliverable, described below in subtask 1.8.1. Temperature is being used as a surrogate for mixing height in this case.

### *1.3 Allocate piston-engine aircraft activity to specified runway using hourly activity profile*

The contractor shall estimate the number of single- and multi-engine piston aircraft full and T&G operations (and helicopter operations as needed in consultation with the WA COR) that occur on the runways in Table 1 in each 24-hour period for all days on which lead in air was monitored at each of the airports in Table 1, assuming the operations are distributed throughout the day based on observed data. The contractor shall use the hourly wind direction data collected in subtask 1.2.1 and analyzed in subtask 1.2.2 as well as the piston activity data calculated in subtask 1.1.1 to calculate the 24-hour sum of operations at the monitored runway. The steps necessary to make this estimation are detailed in Sections 1.3.1, 1.3.2, and 1.3.3 below.

#### *1.3.1 Develop airport-specific hourly full & T&G activity profiles*

The contractor shall develop airport-specific hourly activity profiles for single- and multi-engine aircraft full and T&G operations. To do so, the contractor shall use data previously collected in Assignment No. 0-10 under EPA contract EP-C-12-011 (“Recording Aircraft Operations at General Aviation Airports with Lead Monitors”).

Airport lead monitors in the ambient air lead surveillance network conducted sampling over 24-hour periods every six days. Airports are typically open for operation up to 16 hours per day and previous work conducted by the contractor for EPA’s evaluation of airport lead has demonstrated that piston-engine aircraft activity is not distributed uniformly over the airport operating hours. In order to analyze the relationship between activity and the measured concentration of lead at airport monitors, the contractor shall determine the number of aircraft operations during each hour of the 24-hour period for which lead was monitored.

The contractor shall calculate the hourly activity by single- and multi-engine aircraft separately for full and T&G cycles that was observed under WA no. 0-10 under EPA contract EP-C-12-011. The contractor shall interpolate activity over hours when observations are missing. The contractor shall calculate hourly activity averages by aircraft operation type among the days for which observations are available. All data shall be provided in excel format in the spreadsheet specified in subtask 1.8.3.

#### *1.3.2 Calculate hourly activity*

The contractor shall calculate the number of hourly operations conducted by piston aircraft by type and mode at each of the airports in Table 1<sup>2</sup>. To do so, the contractor shall multiply the daily piston aircraft counts from subtask 1.1.1 by the hourly fraction of activity conducted by each aircraft/mode combination that was determined in section 1.3.1 above. For example, if the single-engine full cycle piston operation total for a day at Merrill Field airport from subtask 1.1.1 was determined to be 100 and if the hourly aircraft activity profile from 1.3.1 at

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<sup>2</sup> The phrase “aircraft and mode type” is being used here as synonymous with single- and multi-engine piston-powered aircraft differentiated by full or T&G cycles as well as helicopter activity, when relevant.



Merrill Field airport indicates that from 11am-noon, 30% of the daily activity by single-engine aircraft conducting full cycle operations occurs, then 30 of that day's single-engine operations would be assigned to the 11am-noon hour.

*1.3.3 Construct daily counts of piston aircraft activity at monitored runways, by mode and type*

The contractor shall use data from subtask 1.2.2 and 1.3.2 to construct daily total counts of piston aircraft activity (by type and mode) at the monitored runway. For example, if the contractor determined in subtask 1.3.2 that there were 30 piston single-engine full operations at Merrill Field airport on January 1, 2013 from 11am-noon and in subtask 1.2.2 determined that during the 11am-noon hour on January 1, 2013, winds came from the direction that would compel the use of the monitored runway at Merrill Field, then 30 single-engine full operations would be assigned to the monitored runway end for that day from 11am-noon. The same procedure should be used for the remaining hours of the monitored day. Hourly piston-engine activity shall then be summed to arrive at individual, day-specific activity at the monitored runway for single- and multi-engine aircraft, full cycle and T&G operations separately. Data from this task shall be included in the Primary Analysis Spreadsheet deliverable, described below in subtask 1.8.1. Specifically, the contractor shall include the 24-hr sum of operations at the monitored runway conducted by single- and multi-engine aircraft broken out by full and T&G operations. This subtask may require inclusion of helicopter operations as provided in written technical direction by the WA COR. These data will similarly be included in the above-specified spreadsheet.

*1.4 Summarize run-up times*

The contractor shall summarize airport-specific average, min, and max run-up times for aircraft observed at each airport using data collected for EPA in Work Assignment No. 0-10 under EPA contract EP-C-12-011 ("Recording Aircraft Operations at General Aviation Airports with Lead Monitors"). This information shall be presented in a table in the final report.

*1.5 Calculate distance between ambient monitor to run-up area*

The contractor shall summarize and present in a table in the final report the distances (in meters) between the ambient air monitor and the run-up area at each of the airports in Table 1.

Siting guidelines for ambient air lead monitors in the lead surveillance network require that monitors are sited in the maximum concentration area that represents ambient air (i.e., an area accessible to the general public). At airports, the maximum concentration areas are located in closest proximity to the run-up and take-off location. Monitor siting must also consider safety issues such as flight path clearance and logistical considerations such as availability of power for the monitoring equipment. These factors resulted in a wide range of distances between the maximum impact location and the location of the NAAQS Federal Reference Method monitors at airport sites. This variability will be

used in subsequent subtasks to evaluate the relationship between aircraft activity and lead concentrations, as well as the gradient in lead concentrations.

For each airport, the contractor shall provide a range of the most likely distance between the run-up area and the monitor. A range of distances is needed to appropriately characterize the actual distance between the run-up location and the monitor because run-up areas can be up to 100 m in length and individual pilots may decide the specific location where they conduct their run-up check. The contractor shall provide the minimum, mean and maximum distance between the run-up location and the monitor. If the data collected in Work Assignment No. 0-10 under EPA contract EP-C-12-011 (“Recording Aircraft Operations at General Aviation Airports with Lead Monitors”) allow informed evaluations to be made about the actual locations where run-up checks were conducted, then the contractor shall provide the most frequently used distance between the run-up area and the monitor as well. The contractor shall specify which run up distance (minimum, mean, maximum, or most frequently used) is used in all documentation of these data included in spreadsheet(s) and word document reports.

#### 1.6 *Develop multivariate and univariate regression equations*

The contractor shall create airport-specific multivariate and univariate regression equations to evaluate the variation in lead concentrations explained by piston aircraft activity, run-up time, avgas concentration, wind speed, temperature and wind direction. The contractor shall also explore regression equations that include input data across all airports in Table 1 along with distance between the monitor and run-up location as an input variable.

The contractor shall report the regression equations in airport-specific tables in the summary report (subtask 1.9). The variables that explain the majority of variation in lead concentrations shall be identified and the relevant equations that include these variables shall be noted for each airport.

The contractor shall report in a table the various regression equations evaluated across all airports that include distance between monitor and run-up location.

The airport-specific tables and table of evaluations across all 6 airports shall be provided in an Excel file, specified in subtask 1.8.4, as well as in the summary report (subtask 1.9).

#### 1.7 *Calculate airport-specific air quality impact factors*

Daily air quality factors for each monitored day shall be calculated at each airport in Table 1 as the concentration of lead monitored divided by the total full cycle operations (sum of single- and multi-engine aircraft) at the runway end listed in Table 1; the total activity data was derived in subtask 1.3.3. Daily air quality factors shall also be calculated that use total full cycle operations *plus* T&G operations (from single- and multi-engine aircraft) as the denominator (derived in subtask 1.3.3) and concentration of lead as the numerator.

For each airport, the contractor shall report basic statistics (i.e., average, minimum, and maximum) of the 24-hour air quality impact factors expressed as the concentration of lead per operation. These statistics shall be included in an Excel file, specified in subtask 1.8.5, as well as in the summary report (subtask 1.9). Each of the 24-hr individual airport air quality impact factors shall also be included in this Excel spreadsheet.

### 1.8 *Develop summary spreadsheets*

The contractor shall develop and provide EPA with the following spreadsheets:

#### 1.8.1 *Primary Analysis Spreadsheet*

Each airport in Table 1 shall be in a separate tab/worksheet within the spreadsheet workbook. The rows in each tab/worksheet shall be the days that monitoring was conducted at that airport. The columns in the table are listed below; subtasks describing how the contractor shall construct each variable are listed in parentheses after each variable description:

- Date (EPA Provided)
- Monitored 24-hr Lead Concentration (EPA Provided)
- ATADS Total GA Operations (EPA Provided)
- ATADS Total AT Operations (EPA Provided)
- Total # Single-Engine Piston Full Ops (task 2.1.1)
- Total # Multi-Engine Piston Full Ops (task 2.1.1)
- Total # Single-Engine Piston T&G Ops (task 2.1.1)
- Total # Multi-Engine Piston T&G Ops (task 2.1.1)
- Total # Single-Engine Piston Full Ops at monitored runway (task 2.3.3)
- Total # Multi-Engine Piston Full Ops at monitored runway (task 2.3.3)
- Total # Single-Engine Piston T&G Ops at monitored runway (task 2.3.3)
- Total # Multi-Engine Piston T&G Ops at monitored runway (task 2.3.3)
- Open Hours Avg. Wind speed (task 2.2.3)
- Open Hours Min. Wind speed (task 2.2.3)
- Open Hours Max. Wind speed (task 2.2.3)
- Open Hours Avg. Temperature (task 2.2.4)

#### 1.8.2 *Meteorology Spreadsheet*

The data collected under subtask 1.2.1 shall be provided to EPA in a spreadsheet; each airport in Table 1 shall be in a separate tab/worksheet within the spreadsheet workbook. The rows of the table shall be each hour during the 24-hours of all air lead monitoring. The columns in the table are listed below:

Hourly Wind Speed  
Hourly Wind Direction  
Hourly Temperature

#### 1.8.3 *Airport-specific hourly profiles*

The contractor shall provide EPA with tables of hourly profiles for each airport in Table 1 as calculated in subtask 1.3.1. Profiles shall be provided for each aircraft type and mode.

#### *1.8.4 Regression Equation Results*

Regression results obtained under subtask 1.6 shall be provided to EPA in a spreadsheet. The contractor shall determine the optimal organization of the spreadsheet.

#### *1.8.5 Air Quality Factor Results*

Air quality factor summary statistics (i.e., average, minimum, and maximum) of the 24-hour air quality impact factors (expressed as the concentration of lead per operation) for each airport in Table 1 shall be provided to EPA in a spreadsheet. Additionally, each of the 24-hr individual airport air quality impact factors shall also be included in this Excel spreadsheet, where each airport's data is located in a separate tab/worksheet.

### *1.9 Develop summary report*

The contractor shall prepare a final report that fully describes all methods and results from Task 1. The report is intended for the general public and staff in other agencies, and thus shall be written to clearly and concisely convey the data, analysis and conclusions of Task 2 to a general audience with varying technical backgrounds. As appropriate, the contractor shall incorporate figures and tables that facilitate quick understanding of the report contents. In addition, it is expected that staff members developing the document played an active role in the data analysis detailed in the previous subtasks, and thus are well versed in the content of the document. Sections 1.9.1 – 1.9.3 below detail the approach for developing the report.

#### *1.9.1 Develop report outline*

The contractor shall develop an outline of the report that proposes, at a high-level, the structure and general contents of the report. The outline shall include a list of proposed figures and tables, the content of each table or figure, and the location of each within the outline. The contractor shall provide the outline in MS Word 2013 for review and approval by the WA COR.

#### *1.9.2 Develop draft report*

The Contractor shall be responsible for developing a draft report that (a) meets rigorous standards of scientific objectivity, logic, and clarity; (b) incorporates appropriate references to relevant government reports or scientific literature (by ongoing searching and evaluation of the relevant technical literature and other sources of pertinent information for possible incorporation in the report); and (c) avoids including excessive or insignificant details, balanced against the need to avoid omitting key points or information likely to be known to experts in the field. In preparing the draft report, the contractor shall immediately contact the WA COR with any questions regarding the content, scope or direction of the report. The contractor shall provide the draft report to the WA COR for review in MS Word 2013 with appropriate formatting to facilitate easily moving through the document (e.g., figures and sections are linked to the table of contents).

### 1.9.3 *Develop final report*

The contractor shall revise the draft report to address EPA comments. In addition, it is expected that staff members revising the document played an active role in drafting the document, and accordingly, review of revisions to the document should require less effort than that required for production of the first draft.

### **Task 2: Collect additional meteorological data for 2014-March 1, 2015**

The contractor shall collect and summarize an additional year (i.e., 2014) of meteorological data beyond that collected in Work Assignment No. 0-10 under EPA contract EP-C-12-011.

In order to collect all the meteorological data necessary for the evaluation of 12 consecutive rolling 3-month activity averages for 2014, the contractor shall collect data from all sites for 2014 and for January – March 1, 2015 (March 1, 2015 is needed in order to capture all of February 2015, given that the standard Integrated Surface Hourly Data (ISHD) is in GMT and AERMET converts to local time).

The contractor shall download NCDC 1-minute ASOS data (available at: <ftp://ftp.ncdc.noaa.gov/pub/data/asos-onemin/>) for all sites that have data for 2014 and January – March 1, 2015. The 1-minute ASOS data shall then be run through AERMINUTE to generate hourly averaged wind speed and wind direction data by station, day, and hour for the 424 days. For hours without ASOS data, the contractor shall replace that observation with the standard hourly ASOS observation so that there are hourly observations for each station – day – hour record in the dataset. The standard hourly ASOS data can be processed through AERMET stage 1 to make it easier to read standard observations and to merge hours.

The contractor shall organize and provide the data to EPA in Excel files. The resulting files shall therefore contain ~9 million records (~900 ASOS stations X 424 days X 24 hours = ~9 million).

An example of one record of desired data output is shown below:

ASOS Station NCDCID	ASOS Station Call	ASOS Station Name	Year	Month	Day	Hour (LST)	Wind Speed	Wind Direction	Data Source (either STD or AER)
20019437	FRG	Farmingdale AP	2012	1	1	1	2.34	300	STD

### **Task 3: Comparison of the piston aircraft fleet active at the Reid-Hillview airport with the national fleet**

The contractor shall compare the types of aircraft used at the Reid-Hillview airport (RHV) with the national piston-engine fleet. Information on the fleet composition at RHV shall come from the analysis completed by the contractor as part of Work Assignment No. 4-1 (“Ambient Lead Concentrations from Piston-Engine Aircraft”) under EPA Contract No. EP-C-06-094. The objective of this comparison is to understand the extent to which the fleet at RHV is representative of the national fleet.

To conduct this analysis, the contractor shall complete the following subtasks:

*3.1 Collect and organize national fleet data*

The aircraft registration database and documentation shall be downloaded from the following website:

[http://www.faa.gov/licenses\\_certificates/aircraft\\_certification/aircraft\\_registry/releasable\\_aircraft\\_download/](http://www.faa.gov/licenses_certificates/aircraft_certification/aircraft_registry/releasable_aircraft_download/). The files shall be imported into Excel and merged to obtain one master database that shall be supplied to EPA. In conjunction with the database, the contractor shall provide appropriate metadata, including the date when data were downloaded from the FAA site, the original file names downloaded from the FAA site, number of rows per table, and data type (integers, strings, etc.) in each column.

*3.2 Analyze national fleet information*

The national piston aircraft fleet information provided in the database developed in subtask 3.1 shall be analyzed and categorized to provide an output file that summarizes the number of piston-engine aircraft by manufacturer and engine type. The output file shall also include metadata, such as type of aircraft (e.g., fixed wing single, fixed wing multi, rotocraft, gyrocraft), type of engine (e.g., reciprocating, 2-stroke, 4-stroke, rotary, unknown), year manufactured, engine horsepower, number of engines, and number of seats.

*3.3 Create RHV data file*

The contractor shall create a parallel file using the data collected in Work Assignment No. 4-1 (“Ambient Lead Concentrations from Piston-Engine Aircraft”) under EPA Contract No. EP-C-06-094. This file shall include the aircraft tail/fin ID number, aircraft manufacturer, engine types, and any additional data available (e.g., engine horsepower)

*3.4 Compare RHV and national fleet composition*

To evaluate how representative the piston aircraft fleet at Reid-Hillview is of the national fleet, the contractor shall compare the data from RHV and the FAA national aircraft registry files created in subtasks 3.3 and 3.2, respectively. In this comparison, the contractor shall provide answers to the questions below in the form of a short report that includes all data summary tables and figures needed to support the observations made.

Questions to be answered regarding the comparison of the fleet at RHV to the national fleet:

- a) How does the distribution of aircraft by manufacturer and engine type compare between the FAA national registry database and the RHV database? The answer shall be provided as a set of observations made when comparing these two fleets. The observations shall be based on comparisons of histograms or frequency distributions of aircraft type and engine type at a minimum.
- b) Was the most commonly or frequently observed aircraft at RHV also the most common aircraft registered in the FAA national registry database?
- c) Were there aircraft observed at RHV that are not common in the FAA national registry database?

- d) Which types of piston engine aircraft in the FAA national database were not observed at RHV and what percent of the national fleet do they compose?

**3.5 Report agriculture and pest control aircraft**

Separately, the contractor shall provide an Excel output file from the FAA registry database that includes the number of aircraft, by engine type, that are used in agriculture and pest control.

#### **IV. SCHEDULE OF DELIVERABLES**

Quality Assurance Project Plan

30 days after WA issue date

Task 1. Analysis of Ambient Air Lead Concentrations Monitored Near Airports in the Lead Surveillance Network.

Twice monthly meetings starting  
Report outline  
All data files listed in subtask 1.8  
Draft report  
Final report

7 days after award  
August 17, 2015  
August 31, 2015  
September 14, 2015  
September 30, 2015

Task 2. Collect meteorological data for 2014

August 31, 2015

Task 3. Comparison of the piston aircraft fleet active at the Reid-Hillview airport with the FAA national registry database.

Draft report  
Final report

August 31, 2015  
September 30, 2015

All deliverables shall be submitted electronically to the WA COR.

#### **V. Other Requirements**

All deliverables will be reviewed for conformance to the requirements of this Project before being approved as final. Final products shall be produced by the Contractor upon the WA COR approval through written technical direction. The Contractor shall provide all materials written as part of these tasks to the WA COR, as per work assignment, in electronic format. Electronic versions shall be compatible with current EPA computer systems and software (e.g., Microsoft Word and Excel 2013).

#### **VI. Special Conditions and Assumptions**

Periodic meetings between the WA COR and contractor staff shall be necessary to discuss questions that may arise during performance or completion of this work assignment. At the WA COR's discretion, these meetings may occur via teleconference or video conferences. The Contractor shall document these meetings and submit copies of this documentation to the WA COR.

<b>EPA</b> United States Environmental Protection Agency Washington, DC 20460 <b>Work Assignment</b>						Work Assignment Number 3-17				
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:				
Contract Number EP-C-12-011			Contract Period 02/01/2012 To 09/30/2015			Title of Work Assignment/SF Site Name				
			Base                      Option Period Number    3			Aircraft CO2 Cost Analysis				
Contractor ICF Incorporated, L.L.C.					Specify Section and paragraph of Contract SOW Task 6 Aircraft Analysis					
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval					Period of Performance  From 10/01/2014 To 09/30/2015					
Comments:										
<input type="checkbox"/> Superfund                      Accounting and Appropriations Data <input checked="" type="checkbox"/> Non-Superfund										
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.										
SFO (Max 2) <input type="checkbox"/>										
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										
Authorized Work Assignment Ceiling										
Contract Period:		Cost/Fee:				LOE:				
02/01/2012 To 09/30/2015										
This Action:										
Total:										
Work Plan / Cost Estimate Approvals										
Contractor WP Dated:				Cost/Fee:			LOE:			
Cumulative Approved:				Cost/Fee:			LOE:			
Work Assignment Manager Name    Bryan Manning							Branch/Mail Code:			
_____ (Signature)                      (Date)							Phone Number    734-214-4832			
							FAX Number:			
Project Officer Name    Greg Janssen							Branch/Mail Code:			
_____ (Signature)                      (Date)							Phone Number: 734-214-4285			
							FAX Number: 734-214-4821			
Other Agency Official Name							Branch/Mail Code:			
_____ (Signature)                      (Date)							Phone Number:			
							FAX Number:			
Contracting Official Name    Sandra Savage							Branch/Mail Code:			
_____ (Signature)                      (Date)							Phone Number: 513-487-2046			
							FAX Number:			



## PERFORMANCE WORK STATEMENT

EPA Contract: EP-C-12-011

Work Assignment (WA): 3-17

Issuing Office: EPA Office of Transportation and Air Quality (OTAQ)  
2000 Traverwood Dr.  
Ann Arbor, Michigan 48105

Contractor: ICF International  
9300 Lee Highway  
Fairfax, VA 22031-1207

Statement of Work: Completion of Aircraft CO<sub>2</sub> Cost Analysis for Technology Improvements to New In-Production Aircraft, and Market Condition Analysis

Work Assignment Contracting Officer Representative (WA COR):  
Bryan Manning  
734-214-4832  
manning.bryan@epa.gov

Alternate WA COR: John Mueller  
734-214-4275  
mueller.john@epa.gov

## BACKGROUND

In November 2013, the International Civil Aviation Organization's (ICAO) Committee on Aviation Environmental Protection (CAEP) decided on the stringency options (or levels) to be analyzed for an aircraft CO<sub>2</sub> standard. In September 2014, CAEP is expected to agree on the technology responses and costs to meet the stringency options. CAEP will then begin a cost effectiveness analysis that will be completed prior to the adoption of a CO<sub>2</sub> standard in late 2015 or early 2016. Work is still needed to inform CAEP future decisions regarding the applicability of the CO<sub>2</sub> standard to new in-production aircraft. There exists a need to assess the market conditions for technological improvements to new in-production aircraft to help develop a projected future fleet of aircraft, which is a key component of the cost effectiveness analysis. There is also a need to assess the use of existing cruise performance data for certification to reduce the costs for manufacturers.

The potential use of alternative compliance mechanisms such as "Averaging and Banking" (AB), in place of the traditional CAEP pass/fail criteria, have been proposed by some members in the CAEP working group. Technical assistance is needed to complete the development of an AB system for the aircraft CO<sub>2</sub> standard. This includes determining how to optimize technological improvements (and/or technology) and minimize costs in the AB system.

## SCOPE

This work assignment 3-17 ("WA 3-17") is a continuation of work assignments 1-17 and 2-17 ("WA 1-17" and "WA 2-17") of EPA contract EP-C-12-011. Under WA's 1-17 and 2-17, the contractor assessed technological improvements to new in-production aircraft and their corresponding costs, and initiated work to develop an AB system. However, due to delays in the CAEP work program and the unanticipated need for more effort to develop technological improvements and costs, the contractor was unable to both complete an averaging and banking system and provide an assessment of how to optimize technological improvements and minimize costs in

the AB system, as specified in WA's 1-17 and 2-17. Thus, under WA 3-17, the contractor shall complete work on the AB system. This shall include the accompanying peer reviews.

## **TASKS**

### **Task 1. Develop an Averaging and Banking System**

AB is an alternative compliance mechanism (in place of the traditional CAEP pass/fail approach) intended to incentivize early implementation of fuel efficient technologies over a wide range of aircraft types. AB allows the CO<sub>2</sub> standard to be met on average by an aircraft manufacturer rather than requiring each aircraft type (or aircraft model) to be below the stringency line (or standard). This is done by earning credits from more efficient aircraft below the stringency line that can be utilized to offset debits from less efficient aircraft above the stringency line. AB provides manufacturers more discretion in determining their individualized strategy and timing for compliance, compared to the traditional CAEP pass/fail approach for standards.

The contractor shall complete the development of an averaging and banking system for the aircraft CO<sub>2</sub> standard and provide an assessment of how to optimize technological improvements and minimize costs in the AB system -- relative to pass/fail approach. This assessment shall include the associated cost and benefits (CO<sub>2</sub> emissions reduction) with the technological improvement approach in the AB system. The contractor shall consult with the EPA WA COR on the approach or modifications to the approach (compared to work initiated in WA's 1-17 and 2-17) used to develop the technology responses and costs in the AB system -- relative to those in the pass/fail approach.

The contractor shall consult with the EPA WA COR before deciding on their methods or changes to their methods (compared to work initiated in WA's 1-17 and 2-17) for developing the AB system (including consulting with the EPA WA COR on options for an averaging or stringency line(s)). The contractor shall provide a technical report to the EPA WA COR on the results of this task.

### **Task 2. Market Conditions for Technological Improvements Analysis (for Fleet Evolution)**

For a pass/fail standard or system (as CAEP is developing), of aircraft (or fleet evolution), which is a key component of the CAEP cost effectiveness analysis, the contractor shall conduct an analysis of investments versus expected returns associated with aircraft response to a stringency option. The contractor shall assess the market conditions for technological improvements to new in-production aircraft to assist in the development of a projected future fleet. An assessment of non-mandatory technology responses shall be used for comparison (for a scenario where the standard just applies to only new type aircraft, but there may still be a technological response for in-production aircraft -- even though it is not required). For the non-mandatory response, the contractor shall make an assessment of the economic reasonableness of technological improvements to in-production aircraft.

The contractor shall consult with the EPA WA COR before deciding on their methods for the market condition analysis. The contractor shall provide a technical report to the EPA WA COR on the results of this task.

In the course of developing this assessment of the market conditions for technological improvements, the contractor shall participate in the discussions of the topic in a CAEP working group. This shall include participating in meetings and teleconferences as needed and assisting in the drafting of technical papers of the CAEP working group. The contractor shall consult with EPA WA COR in preparation for these discussions and drafting of the technical papers. In addition, the contractor shall travel to at least two CAEP working group meetings to make presentations on the results of the technical papers (or assist in providing presentations on these papers) and the technical report, as provided in written technical direction by the EPA WA COR.

The first CAEP meeting will be January 26-30, 2015 in Savannah, Georgia, and the second meeting will be in April 2015 in Cologne, Germany (expected to be a week-long meeting, but the specific April dates are to be determined). The contractor shall participate in 2 to 3 days of each of these week-long meetings. The presentations shall be in MS Word or PowerPoint format and about 1 hour in duration. In the presentations, the contractor shall describe the methods and results of their assessments.

### **Task 3. Peer Review and Publication in Scientific Journal of Technical Report**

The contractor shall identify at least two aircraft technology and cost/economics experts to separately peer review the AB system from Task 1. These experts shall have substantial experience with assessing costs/economics of new in-production technology, and they shall be familiar with the ICAO/CAEP processes. In addition, the contractor shall find two peer reviewers of the market conditions analysis developed in Task 2; these peer reviewers can be different than the peer reviewers for Tasks 1. The contractor shall have the peer review experts provide reviews of the Task 1 and Task 2 reports (draft versions as well as the final reports) so that there is an opportunity to revise the report based on the input from the peer reviewers. In addition, the contractor shall have the peer reviewers develop a memorandum summarizing their views of the draft versions of the cost curve and reports -- and the final reports. Based on these peer reviewer memorandums and consultations with EPA, the contractor shall provide a final technical report to the EPA WA COR on the results of Tasks 1 and 2. The contractor shall consult with the EPA WA COR before deciding on the peer reviewers. However, the final decision on selection of the particular peer reviewers shall be made by the contractor.

There is a metric values database (MVdb) and project aircraft metric value database (PAMVdb) for the CAEP CO2 Standard Task Group. The MVdb and PAMVdb are based on data from the aircraft manufacturers, and they consider this data to be proprietary in nature. The contractor shall ensure the confidentiality of the data in accordance with the contractual requirements relating to confidential business information. The peer reviewers would likely not have permission to access the MVdb and the PAMVdb, and thus, the proprietary nature of the data needs to be maintained by the contractor for these peer reviews. The contractor shall consult with the EPA WA COR prior to sending the Task 1 and 2 technical reports (draft version and final reports) to the peer reviewers.

In addition, for Task 1 (*Develop an Averaging and Banking System*) from this WA 3-17, Task 1 from WA 1-17 (*Identify Technology Improvements to New In-production Aircraft*), and Task 1 from WA 2-17 (*Cost Analysis of Technological Improvements for New In-Production Aircraft*), the contractor shall attempt to publish their work (or technical report(s)) in a scientific or engineering journal, according to the contract terms and written technical directions from the EPA WA COR. The outcome of these three tasks needs to be published in this manner to enhance the visibility and vetting process (in addition to the peer reviews described above and in WA's 1-17 and 2-17) of the work products or report(s) provided by the contractor.

### **Task 4. Methods to Use Existing Cruise Performance Data for In-Production Aircraft**

CAEP is working to define potential options to implement applicability requirements for in-production aircraft. CAEP is also evaluating the acceptability of utilizing existing cruise performance data for these aircraft (instead of conducting flight tests to generate new data for in-production aircraft). This evaluation will clarify the potential requirements for in-production aircraft in meeting the CO2 standard. The assessment will require detailed discussions between the members of a CAEP working group for the development of technical papers. The contractor shall participate in these discussions (which occur via conference calls about twice per month) and assist in the drafting of the technical papers. The contractor shall consult with the EPA WA COR in preparation for these discussions and drafting of the technical papers. After the technical papers are completed, the contractor shall provide a separate technical review of these papers to the EPA WA COR.

The contractor shall provide concepts or ideas for simplifying (or reducing the burden on manufacturers) the requirements for in-production aircraft (compared to new aircraft types). This includes developing concepts for a transitional phase-in of the standard to different categories of in-production aircraft in order to balance the effectiveness of applicability requirements versus the resource and planning issues associated with implementation of the requirements. The contractor shall provide a technical report to the EPA WA COR on the results of this task.

In addition, the contractor shall travel to at least three CAEP meetings to make presentations on the results of the technical papers (or assist in providing presentations on these papers) and the technical report, as provided in written technical direction by the EPA WA COR. The first CAEP meeting will be November 3-7, 2014 in Paris, France, the second meeting will be in February 2015 in Washington, DC, and the third meeting will be in May 2015 in Belfast, Ireland (specific dates for the second and third meetings are to be determined, each meeting will be one week). The contractor shall participate in 2 to 3 days of each of these week-long meetings. The presentations shall be in MS Word or PowerPoint format and about 1 hour in duration. In the presentations, the contractor shall describe the methods and results of their assessments.

## **DELIVERABLES**

### Kick off Meeting

Within one week after receipt of the work assignment, and prior to the Contractor submitting a Work Plan, the Contractor shall discuss this work assignment with the EPA WA COR to ensure a common understanding of the requirements, expectations, and ultimate end products.

### Quality Assurance Project Plan (QAPP)

The contractor shall submit a draft QAPP to the EPA WA COR within 2 weeks of receipt of Work Plan approval. The QAPP approved under WA 1-17 (and WA 2-17) of this contract may be used as a model if there are no substantial changes due to this WA 3-17. The QAPP shall detail data collection and analysis tasks and procedures for this work assignment. The EPA WA COR shall review and comment on the QAPP. The contractor shall incorporate recommended changes and suggestions received before proceeding with technical work associated with the tasks below. A final QAPP shall be submitted within 2 weeks of receipt of EPA comments on the draft QAPP. Information on completing a QAPP can be found at <http://epa.gov/quality/qs-docs/r5-final.pdf> (general requirements) and <http://epa.gov/quality/qs-docs/g5-final.pdf>

The final QAPP shall cover all aspects of this test program as outlined on the EPA quality website. The QAPP shall have an appendix containing all applicable standard operating procedures (SOPs). The contractor shall adhere to all applicable SOPs and the QA procedures recommended therein.

### Technical Reports and Memorandums

See Schedule section below for deadlines. The contractor shall provide the technical reports and memorandums for Tasks 1, 2, 3, and 4 as described below. The contractor shall provide an electronic copy of all reports, memorandums, spreadsheets, supporting materials, etc., to the EPA WA COR with the final report (by the deadline listed for the peer reviewers memorandum on the final report in the Schedule section). Electronic copies shall be in formats (e.g., Word, Excel) specified by the EPA WA COR in written technical direction.

### Bi-Weekly Progress Reports

The contractor shall provide the EPA WA COR with brief bi-weekly (every other week) status reports via telephone conference or email during the period of performance. The progress report shall indicate the progress achieved in the preceding weeks, technical problems encountered, solutions to those problems, and projected activity for the upcoming weeks. Before proceeding with any solution to a problem, the contractor shall report the problem and consult with the EPA WA COR concerning the scope of the solution.

### **SCHEDULE OF DELIVERABLES**

	<b>Item</b>	<b>Due Date</b>
1	Kick off Meeting	Within 1 week after receipt of work assignment
2	Draft QAPP submitted to EPA	Within 2 weeks of work plan approval
3	Final QAPP submitted to EPA	Within 2 weeks of receipt of EPA comments on draft QAPP
4	Task 1 draft report submitted to WA COR	11/14/14
5	Task 1 comments received from WA COR	11/28/14
6	Task 1 draft report submitted to peer reviewers	12/5/14
7	Task 1 comments received from peer reviewers	12/31/14
8	Task 1 final report submitted to WA COR	1/16/15
9	Task 1 final report comments received from WA COR	1/30/15
10	Task 1 final report submitted to WA COR	2/6/15
11	Draft scientific journal paper/article submitted to WA COR (as described in Task 3)	2/20/15
12	Draft scientific journal paper/article comments received from WA COR	3/6/15
13	Final scientific journal paper/article submitted to WA COR	3/13/15
14	Final scientific journal paper/article comments received from WA COR	3/20/15
15	Final paper/article submitted to scientific journal	3/30/15
16	Task 2 draft report submitted to WA COR	4/6/15
17	Task 2 comments received from WA COR	4/17/15
18	Task 2 draft report submitted to peer reviewers	5/1/15
19	Task 2 comments received from peer reviewers	5/29/15
20	Task 2 final report submitted to WA COR	6/19/15
21	Task 4 draft report submitted to WA COR	7/10/15
22	Task 2 final report comments received from WA COR	7/17/15
23	Task 4 comments received from WA COR	7/31/15
24	Task 2 final report submitted to peer reviewers	8/7/15
25	Task 4 final report submitted to WA COR	8/21/15
26	Task 2 final report comments received from peer reviewers	8/28/15
27	Task 4 final report comments received from WA COR	9/4/15
28	Final Report on Tasks 2 and 4	9/25/15
29	Peer reviewers memorandum & Report for Tasks 1 & 2	9/30/15
30	Published Article in Scientific or Engineering Journal	9/30/15
31	Travel to CAEP meetings and participation in conference calls (in this time period)	10/15/14 through 9/30/15

**NON-DISCLOSURE AGREEMENT**

All documentation acquired and/or provided by EPA or generated as a result of this project shall be under the control of the U.S. EPA Assistant Administrator for Air and Radiation, or his or her designated representative, and shall not be released by the Contractor to any other source without specific approval by the U.S. EPA.

<b>EPA</b> United States Environmental Protection Agency Washington, DC 20460 <b>Work Assignment</b>						Work Assignment Number 3-22				
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:				
Contract Number EP-C-12-011			Contract Period   02/01/2012   To   09/30/2015 Base                      Option Period Number       3			Title of Work Assignment/SF Site Name Particle Losses				
Contractor ICF Incorporated, L.L.C.						Specify Section and paragraph of Contract SOW Task 6 Aircraft; Task 12 Technical Support				
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval						Period of Performance  From   10/01/2014   To   02/28/2015				
Comments:										
<div style="display: flex; justify-content: space-between;"> <input type="checkbox"/> Superfund         <span>Accounting and Appropriations Data</span> <input checked="" type="checkbox"/> Non-Superfund       </div>										
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.										
SFO (Max 2) <input type="checkbox"/>										
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										
Authorized Work Assignment Ceiling										
Contract Period:                      Cost/Fee:                      LOE: 02/01/2012   To   09/30/2015										
This Action:										
Total:										
Work Plan / Cost Estimate Approvals										
Contractor WP Dated:                      Cost/Fee:                      LOE:										
Cumulative Approved:                      Cost/Fee:                      LOE:										
Work Assignment Manager Name   Bob Giannelli  <div style="display: flex; justify-content: space-between;"> <div>_____</div> <div>_____</div> </div> <div style="display: flex; justify-content: space-between;"> <div>(Signature)</div> <div>(Date)</div> </div>							Branch/Mail Code: Phone Number   734-214-4708 FAX Number:			
Project Officer Name   Greg Janssen  <div style="display: flex; justify-content: space-between;"> <div>_____</div> <div>_____</div> </div> <div style="display: flex; justify-content: space-between;"> <div>(Signature)</div> <div>(Date)</div> </div>							Branch/Mail Code: Phone Number: 734-214-4285 FAX Number:   734-214-4821			
Other Agency Official Name  <div style="display: flex; justify-content: space-between;"> <div>_____</div> <div>_____</div> </div> <div style="display: flex; justify-content: space-between;"> <div>(Signature)</div> <div>(Date)</div> </div>							Branch/Mail Code: Phone Number: FAX Number:			
Contracting Official Name   Sandra Savage  <div style="display: flex; justify-content: space-between;"> <div>_____</div> <div>_____</div> </div> <div style="display: flex; justify-content: space-between;"> <div>(Signature)</div> <div>(Date)</div> </div>							Branch/Mail Code: Phone Number: 513-487-2046 FAX Number:			

## PERFORMANCE WORK STATEMENT

EPA Contract:	EP-C-12-011
Work Assignment (WA):	3-22
Issuing Office:	US Environmental Protection Agency Office of Transportation and Air Quality (OTAQ) 2000 Traverwood Dr. Ann Arbor, Michigan 48105
Contractor:	ICF International 9300 Lee Highway Fairfax, VA 22031-1207
Statement of Work:	Mass and Number Particle Losses in an Aircraft PM Sampling System - Continuation
Period of Performance:	October 1, 2014 – February 28, 2015
Work Assignment Contracting Officer Representative (WA COR):	Bob Giannelli 734-214-4708 giannelli.bob@epa.gov
Alternate WA COR:	Bryan Manning 734-214-4832 manning.bryan@epa.gov

This work assignment continues work started under Work Assignment 1-22 and continued under WA 2-22 of this contract.

## BACKGROUND

Measurement of particulate matter (PM) emissions from combustion engines is motivated by their detrimental health and welfare effects. PM emissions from combustion sources are chemically complex and, due to their size, have sampling train transport properties different than gaseous emissions and hence need careful consideration. When designing a sampling system for measuring PM emissions, a concern is the inherent sample losses that can take place in the sampling train during transport from the emissions source to the measurement instrument. These losses, due mostly to well understood physical phenomena, can lead to an underestimation of the amount of the actual PM emissions from the combustion source under consideration.



Under the request of the United Nations International Civil Aviation Organization's (ICAO) Committee on Aviation Environmental Protection (CAEP), the Society of Automotive Engineers (SAE) has established a Standards Committee, named E31, which is developing a sampling system to measure PM emitted from turbo fan aircraft engines. The sampling train has been determined to require sample line lengths and sampling train configurations which lead to what are basically unavoidable sample losses that impact both size and mass measurement. Estimates of the nonvolatile particulate matter (nvPM) mass percent loss in the sample train due to these physical phenomena are >30 percent. Particle number loss estimates are >40 percent.

These large losses lead to a reasonable concern over the accuracy of the measurement method. Hence, the E31 nvPM committee has developed a method by which the nvPM measurements can be adjusted for sample train losses based on estimated particle size distribution and penetration fractions.

This method has been reviewed internally by the E31 committee and by outside experts (EPA contract EP-C-12-011, Work Assignment 1-11). At this point, the line loss method needs to be documented for SAE and eventually for ICAO CAEP as part of a draft test procedure. Hence, the EPA requires assistance in documenting the sample train loss estimation method in a standard format acceptable to the SAE Committee and developing computer models to account and adjust for PM loss under the test procedure being developed.

## **TASKS**

The purpose of this work assignment (WA) is to have experts on aircraft PM measurement assist in the preparation of a draft Aerospace Information Report (AIR) describing the PM loss estimation method and create computer models for PM loss.

### Task 1: Provide technical expert for methodology documentation

The contractor shall identify at least one expert on physical and numerical modeling and aircraft engine emissions characterization, who is knowledgeable on measurement of nvPM emissions and analysis of PM loss in the PM measurement sample trains for both mass and particle number measurement. The contractor shall consult with the EPA WA COR regarding the expert's qualifications before making a selection; EPA has provided a list of several known experts in the field. This is not an all-inclusive or comprehensive list of subject matter experts, and does not limit the contractor in finding and selecting the technical expert.

The EPA WA COR will acknowledge approval of the expert selected on aircraft PM measurement via written technical direction. The contractor shall not consult the EPA WA COR in the final determination of the expert selected.

*List of known technical experts:*

- 1) Dr. Rick Miake-Lye (Aerodyne Research, Billerica, MA)
- 2) Dr. David Kittleson (University of Minnesota, Minneapolis, MN)
- 3) Dr. Ahmad Khalek (Southwest Research Institute, San Antonio, TX)
- 4) Dr. Max Zhang (Cornell University, Ithaca, NY)
- 5) David S. Liscinsky (United Technologies Research Center, East Hartford, CT)

#### Task 2: Attend E31 Loss Team Meetings

For the period of this work assignment (see below), the selected expert from Task 1 shall attend weekly E31 loss team teleconference meetings, communicate, and coordinate with loss team members on the loss correction methods. The approximate duration of these weekly meetings is one hour.

#### Task 3: Methodology Development Documentation

The selected expert from Task 1 shall communicate and coordinate with loss team members on the loss correction methods. The selected expert shall prepare a draft AIR documenting the methods being developed by the SAE E31 to account and adjust for PM loss in the sample trains for both the mass and number aircraft engine PM measurement under the test procedure being developed by E31.

The AIR should follow the format prescribed by SAE (e.g., <http://www.sae.org/servlets/works/>). The SAE AIR 6241 may serve as an example of the format, but the contractor shall use his/her knowledge of the topic area and the draft materials prepared by E31 as the basis for identifying section and sub-sections topics.

#### Task 4: Provide technical expert for model development

The contractor shall identify at least one expert (different from the expert in Task 1) on modeling and aircraft engine nvPM emissions characterization. This expert shall have demonstrated experience with the measurement of nvPM emissions from aircraft engines and the development of PM loss particle penetration fraction models for PM measurement sample trains for both mass and particle number measurement from aircraft engines. The contractor shall consult with the EPA WA COR regarding the expert's qualifications before making a selection; EPA has provided a list of several known experts in the field. This is not

an all-inclusive or comprehensive list of subject matter experts, and does not limit the contractor in finding and selecting the technical expert.

The EPA WA COR will acknowledge approval of the expert selected on aircraft PM measurement via written technical direction. The contractor shall not consult the EPA WA COR in the final determination of the expert selected.

*List of known technical experts:*

- 1) David S. Liscinsky (United Technologies Research Center, East Hartford, CT)
- 2) David Y.H. Pui (University of Minnesota, Minneapolis, MN)
- 3) Heidi Hollick (United Technologies Research Center, East Hartford, CT)
- 4) Dr. Max Zhang (Cornell University, Ithaca, NY)
- 5) Dr. Ahmad Khalek (Southwest Research Institute, San Antonio, TX)

Task 5: Develop PM Loss Models

The selected expert from Task 4 shall develop a PM loss model for the SAE E31 to account for and adjust for diffusion and thermophoretic PM losses in the sample trains for both the mass and number aircraft engine PM measurement under the test procedure being developed by E31. (See AIR 6241<sup>1</sup>.)

**DELIVERABLES**

1. Kick-off Meeting. Within one week after the Work Assignment is issued, but prior to the Contractor submitting a Work Plan, the Contractor shall discuss this work assignment with the EPA WA COR to ensure a common understanding of the requirements, expectations, and ultimate end products.

2. Quality Assurance Project Plan (QAPP). The QAPP prepared under WA 2-22 shall continue to apply under this WA 3-22.

3. Weekly Progress Reports. The contractor shall provide the EPA WA COR with brief weekly status reports via telephone conference or email during the period of performance. The progress report shall indicate the progress achieved in the concluded weeks, technical problems encountered, solutions to those problems, and projected activity for the upcoming weeks. Before proceeding with any solution to a problem, the contractor shall report the problem and consult with the EPA WA COR concerning the scope of the solution.

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<sup>1</sup> <http://www.sae.org/servlets/works/committeeHome.do?comtID=TEAE31>

### Schedule of Deliverables

Steps	Completion Date
Kick Off Meeting	Within 1 week of receipt of Work Assignment
Complete candidate search Task 1 (Documentation)	October 18, 2013
Complete candidate search Task 4 (Create Models)	October 18, 2013
Attend E31 meetings	February 28, 2015
Prepare Draft AIR	February 28, 2015
Develop PM Loss Models	February 28, 2015

### NON-DISCLOSURE AGREEMENT

All documentation acquired and/or provided by EPA or generated as a result of this project shall be under the control of the U.S. EPA Assistant Administrator for Air and Radiation, or his or her designated representative, and shall not be released by the Contractor to any other source without specific approval by the U.S. EPA.

<b>EPA</b> United States Environmental Protection Agency Washington, DC 20460 <b>Work Assignment</b>						Work Assignment Number 3-22				
						<input type="checkbox"/> Other <input checked="" type="checkbox"/> Amendment Number: 000001				
Contract Number EP-C-12-011			Contract Period   02/01/2012   To   09/30/2015 Base                      Option Period Number       3			Title of Work Assignment/SF Site Name Particle Losses				
Contractor ICF INCORPORATED, L.L.C.					Specify Section and paragraph of Contract SOW Task 6 Aircraft Analysis; Task 12 Tech Support					
Purpose: <input type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input checked="" type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval						Period of Performance  From   10/01/2014   To   09/30/2015				
Comments: This amendment extends the period of performance through September 30, 2015 and provides for anticipated contractor travel to complete task requirements. Note that travel must be approved in advance by the contract-level COR in accordance with clause H-22.										
<input type="checkbox"/> Superfund    Accounting and Appropriations Data <input checked="" type="checkbox"/> Non-Superfund										
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.										
SFO (Max 2) <input type="checkbox"/>										
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										
Authorized Work Assignment Ceiling										
Contract Period:		Cost/Fee:			LOE:					
02/01/2012   To   09/30/2015										
This Action:										
Total:										
Work Plan / Cost Estimate Approvals										
Contractor WP Dated:				Cost/Fee:			LOE:			
Cumulative Approved:				Cost/Fee:			LOE:			
Work Assignment Manager Name   Bob Giannelli							Branch/Mail Code:			
_____ (Signature)    (Date)							Phone Number   734-214-4708			
							FAX Number:			
Project Officer Name   Greg Janssen							Branch/Mail Code:			
_____ (Signature)    (Date)							Phone Number: 734-214-4285			
							FAX Number: 734-214-4821			
Other Agency Official Name							Branch/Mail Code:			
_____ (Signature)    (Date)							Phone Number:			
							FAX Number:			
Contracting Official Name   Sandra Savage							Branch/Mail Code:			
_____ (Signature)    (Date)							Phone Number: 513-487-2046			
							FAX Number:			

**PERFORMANCE WORK STATEMENT**

EPA Contract:	EP-C-12-011
Work Assignment (WA):	3-22, Amendment 1
Issuing Office:	US Environmental Protection Agency Office of Transportation and Air Quality (OTAQ) 2000 Traverwood Dr. Ann Arbor, Michigan 48105
Contractor:	ICF International 9300 Lee Highway Fairfax, VA 22031-1207
Statement of Work:	Mass and Number Particle Losses in an Aircraft PM Sampling System - Continuation
Period of Performance:	October 1, 2014 – September 30, 2015
Work Assignment Contracting Officer Representative (WA COR):	Bob Giannelli 734-214-4708 giannelli.bob@epa.gov
Alternate WA COR:	Bryan Manning 734-214-4832 manning.bryan@epa.gov

**This amendment extends the period of performance through September 30, 2015 and anticipates that travel may be expected to complete task requirements.**

This work assignment continues work started under Work Assignment 1-22 and continued under WA 2-22 of this contract.

**BACKGROUND**

Measurement of particulate matter (PM) emissions from combustion engines is motivated by their detrimental health and welfare effects. PM emissions from combustion sources are chemically complex and, due to their size, have sampling train transport properties different than gaseous emissions and hence need careful consideration. When designing a sampling system for measuring PM emissions, a concern is the inherent sample losses that can take place in the sampling train during transport from the emissions source to the measurement instrument. These losses, due mostly to well understood physical phenomena,

can lead to an underestimation of the amount of the actual PM emissions from the combustion source under consideration.

Under the request of the United Nations International Civil Aviation Organization's (ICAO) Committee on Aviation Environmental Protection (CAEP), the Society of Automotive Engineers (SAE) has established a Standards Committee, named E31, which is developing a sampling system to measure PM emitted from turbo fan aircraft engines. The sampling train has been determined to require sample line lengths and sampling train configurations which lead to what are basically unavoidable sample losses that impact both size and mass measurement. Estimates of the nonvolatile particulate matter (nvPM) mass percent loss in the sample train due to these physical phenomena are >30 percent. Particle number loss estimates are >40 percent.

These large losses lead to a reasonable concern over the accuracy of the measurement method. Hence, the E31 nvPM committee has developed a method by which the nvPM measurements can be adjusted for sample train losses based on estimated particle size distribution and penetration fractions.

This method has been reviewed internally by the E31 committee and by outside experts (EPA contract EP-C-12-011, Work Assignment 1-11). At this point, the line loss method needs to be documented for SAE and eventually for ICAO CAEP as part of a draft test procedure. Hence, the EPA requires assistance in documenting the sample train loss estimation method in a standard format acceptable to the SAE Committee and developing computer models to account and adjust for PM loss under the test procedure being developed.

## **TASKS**

The purpose of this work assignment (WA) is to have experts on aircraft PM measurement assist in the preparation of a draft Aerospace Information Report (AIR) describing the PM loss estimation method and create computer models for PM loss.

### Task 1: Provide technical expert for methodology documentation

The contractor shall identify at least one expert on physical and numerical modeling and aircraft engine emissions characterization, who is knowledgeable on measurement of nvPM emissions and analysis of PM loss in the PM measurement sample trains for both mass and particle number measurement. The contractor shall consult with the EPA WA COR regarding the expert's qualifications before making a selection; EPA has provided a list of several known experts in the field. This is not an all-inclusive or comprehensive list of

subject matter experts, and does not limit the contractor in finding and selecting the technical expert.

The EPA WA COR will acknowledge approval of the expert selected on aircraft PM measurement via written technical direction. The contractor shall not consult the EPA WA COR in the final determination of the expert selected.

*List of known technical experts:*

- 1) Dr. Rick Mlake-Lye (Aerodyne Research, Billerica, MA)
- 2) Dr. David Kittleson (University of Minnesota, Minneapolis, MN)
- 3) Dr. Ahmad Khalek (Southwest Research Institute, San Antonio, TX)
- 4) Dr. Max Zhang (Cornell University, Ithaca, NY)
- 5) David S. Liscinsky (United Technologies Research Center, East Hartford, CT)

Task 2: Attend E31 Loss Team Meetings

For the period of this work assignment (see below), the selected expert from Task 1 shall attend weekly E31 loss team teleconference meetings, communicate, and coordinate with loss team members on the loss correction methods. The approximate duration of these weekly meetings is one hour. Travel to meetings may also be necessary as part of this task.

Task 3: Methodology Development Documentation

The selected expert from Task 1 shall communicate and coordinate with loss team members on the loss correction methods. The selected expert shall prepare a draft AIR documenting the methods being developed by the SAE E31 to account and adjust for PM loss in the sample trains for both the mass and number aircraft engine PM measurement under the test procedure being developed by E31. Travel to meetings may be necessary as part of this task.

The AIR should follow the format prescribed by SAE (e.g., <http://www.sae.org/servlets/works/>). The SAE AIR 6241 may serve as an example of the format, but the contractor shall use his/her knowledge of the topic area and the draft materials prepared by E31 as the basis for identifying section and sub-sections topics.

Task 4: Provide technical expert for model development

The contractor shall identify at least one expert (different from the expert in Task 1) on modeling and aircraft engine nvPM emissions characterization. This expert shall have demonstrated experience with the measurement of nvPM emissions from aircraft engines and the development of PM loss particle penetration



fraction models for PM measurement sample trains for both mass and particle number measurement from aircraft engines. The contractor shall consult with the EPA WA COR regarding the expert's qualifications before making a selection; EPA has provided a list of several known experts in the field. This is not an all-inclusive or comprehensive list of subject matter experts, and does not limit the contractor in finding and selecting the technical expert.

The EPA WA COR will acknowledge approval of the expert selected on aircraft PM measurement via written technical direction. The contractor shall not consult the EPA WA COR in the final determination of the expert selected.

*List of known technical experts:*

- 1) David S. Liscinsky (United Technologies Research Center, East Hartford, CT)
- 2) David Y.H. Pui (University of Minnesota, Minneapolis, MN)
- 3) Heidi Hollick (United Technologies Research Center, East Hartford, CT)
- 4) Dr. Max Zhang (Cornell University, Ithaca, NY)
- 5) Dr. Ahmad Khalek (Southwest Research Institute, San Antonio, TX)

#### Task 5: Develop PM Loss Models

The selected expert from Task 4 shall develop a PM loss model for the SAE E31 to account for and adjust for diffusion and thermophoretic PM losses in the sample trains for both the mass and number aircraft engine PM measurement under the test procedure being developed by E31. (See AIR 6241<sup>1</sup>.) Travel to meetings may be necessary as part of this task.

## **TRAVEL**

Communication with experts working on similar and related work to that contained in this work assignment is vital to ensure that the end products incorporate state-of-the-art knowledge. To the extent that such communication cannot reasonably be fulfilled via conference call, the contractor shall expect to travel in order to present, demonstrate, or observe findings related to the work contained in this work assignment. The contractor shall obtain prior approval from the contract-level COR for each instance of travel contemplated as a direct charge under this work assignment in accordance with clause H-22 of the contract. The contractor shall plan for **one two week** trip for **2** persons to **Tullahoma, TN**.

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<sup>1</sup> <http://www.sae.org/servlets/works/committeeHome.do?comtID=TEAE31>

## DELIVERABLES

1. Kick-off Meeting. Within one week after the Work Assignment is issued, but prior to the Contractor submitting a Work Plan, the Contractor shall discuss this work assignment with the EPA WA COR to ensure a common understanding of the requirements, expectations, and ultimate end products.

2. Quality Assurance Project Plan (QAPP). The QAPP prepared under WA 2-22 shall continue to apply under this WA 3-22.

3. Weekly Progress Reports. The contractor shall provide the EPA WA COR with brief weekly status reports via telephone conference or email during the period of performance. The progress report shall indicate the progress achieved in the concluded weeks, technical problems encountered, solutions to those problems, and projected activity for the upcoming weeks. Before proceeding with any solution to a problem, the contractor shall report the problem and consult with the EPA WA COR concerning the scope of the solution.

### Schedule of Deliverables

Steps	Completion Date
Kick Off Meeting	Within 1 week of receipt of Work Assignment
Complete candidate search Task 1 (Documentation)	October 18, 2013
Complete candidate search Task 4 (Create Models)	October 18, 2013
Attend E31 meetings	September 30, 2015
Prepare Draft AIR	September 30, 2015
Develop PM Loss Models	September 30, 2015

### NON-DISCLOSURE AGREEMENT

All documentation acquired and/or provided by EPA or generated as a result of this project shall be under the control of the U.S. EPA Assistant Administrator for Air and Radiation, or his or her designated representative, and shall not be released by the Contractor to any other source without specific approval by the U.S. EPA.